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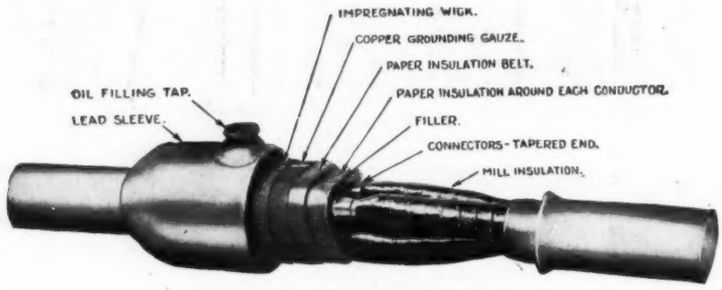
*July 28, 1923*

# Electrical World

Pouring one of the three 4-ton Heroult steel furnaces at Saxon Steel Works, Döhlen, Germany

**Experience with Explosion Chambers in Oil Breakers—Electric Furnaces in Germany—Breakdown Tests on Current Transformers—Central Station Customers in Ohio and Illinois by Counties—Handling Heavy Trash in Forebays — Status of Electric Vehicle**

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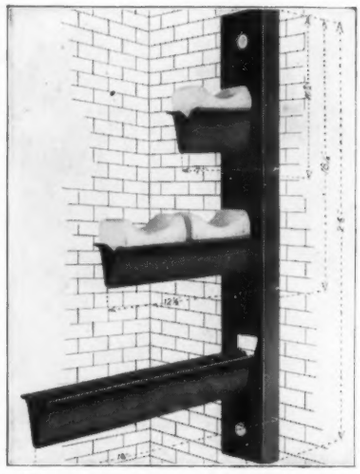

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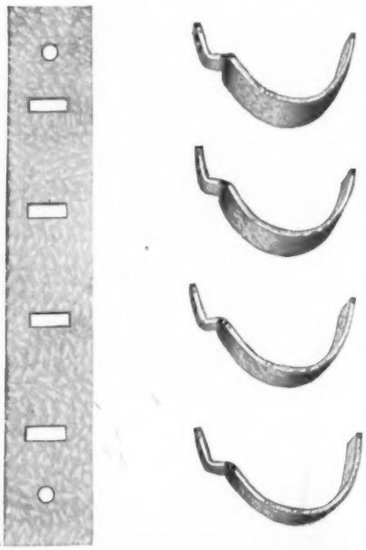

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# Electrical World

*The consolidation of Electrical World, Electrical Engineer and American Electrician*

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W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

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## Kinds of Leadership

INSTINCTIVELY mankind seeks leadership. In the days of youth "the gang" always had a leader, and as life progressed a series of leaders swayed the actions. And recently there has been renewed interest in leadership at the conventions of engineers and engineering educators. Many seem to feel that the engineer is responsible for the present mechanistic civilization and should shoulder the burden of guiding its political and social destiny. And often the comment is heard that engineers should be trained in the colleges to become leaders.

Leadership in a social sense denotes the power to decide, the power to think, the power to act and the power to influence others to carry out decisions. Such leadership is of the highest type and cannot well be produced by any system of training. Executives can be trained, but leaders fill no general specification and remain distinct personalities, in the same category as geniuses.

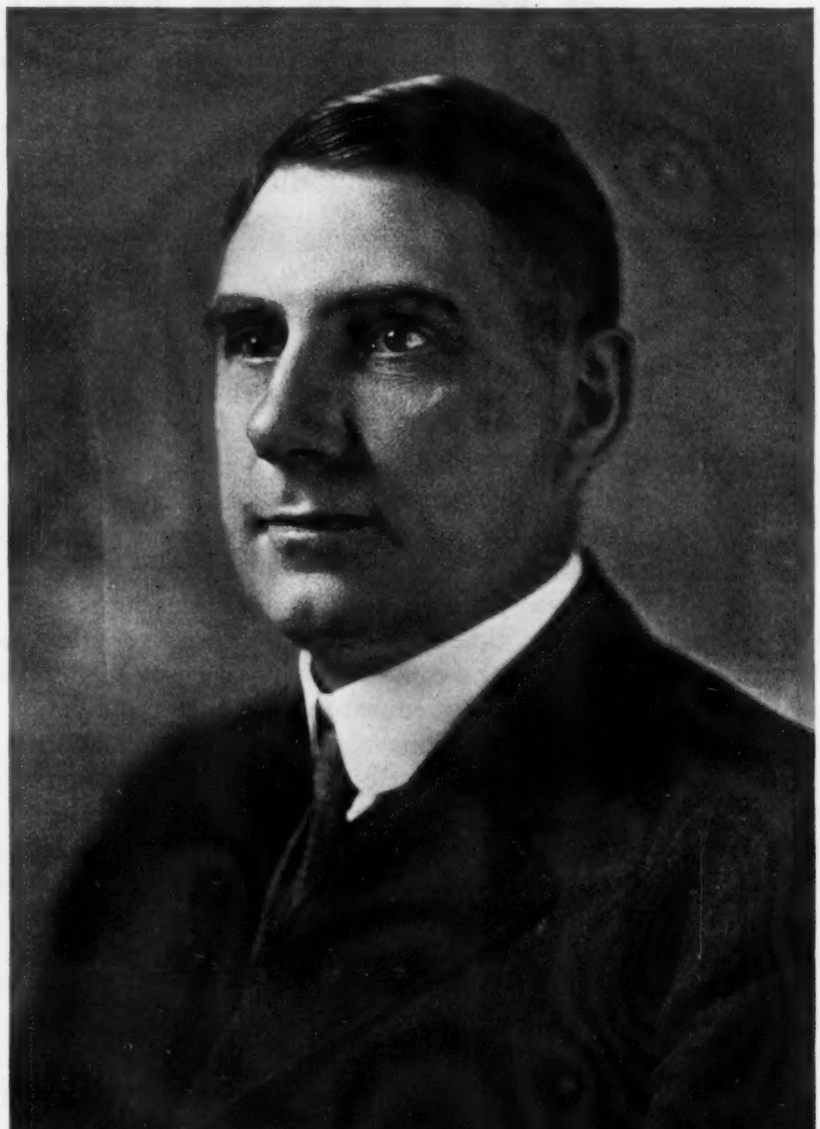
The engineer, merely as an engineer, is not particularly apt to assume a place as this type of leader. In fact, the inherent traits of his personality and type of mind as an engineer would hardly lead to an expectation that he would. The ability to think logically, critically and with constructive imagination is his, but the warmth, color, feeling and intuitive understanding of human nature essential to the highest type of national leader are frequently missing in his make-up. Fortunate will be this country, however, if some engineers who do have the proper characteristics awaken to the possibilities of higher leadership and strive for its attainment.

But in another type of leadership the engineer can and should assume a more important position. Scientific leadership is one of the most effective and permanent contributions that can be given to civilization, and in this field the engineer stands alone. The achievements in applied science during the past few years have had a tremendous influence on national, political and social well-being in addition to their more materialistic accomplishments.

In the light of developments of the past it may well be that the greatest contributions to civilization would be new inventions, new agencies, new machines and new energy applications because of their indirect influence on civilization and standards of living. And thus, a greater recognition of the merits of engineering research and invention might prove a more logical procedure than the introduction of too many so-called humanitarian courses in the engineering colleges in an attempt to develop social leadership.

# Albert Lyndon Marsh

*Noted for the development of alloys of nickel and chromium, which have contributed so greatly to the industrial supremacy of electricity.*



THE advent of the nickel chromium alloy made possible a wide range of new applications of electricity for industrial purposes and made feasible the development of household heating appliances which add greatly to the comfort and convenience of life.

In large measure the new alloy was the contribution of Albert Lyndon Marsh, who worked and experimented many years before he developed a successful product. His optimism, industry and persistency at last permitted him to contribute to the electrical field an alloy which has been used in a multitude of ways and has been far reaching in making possible a greater use of electrical energy in the factory and in the home.

Mr. Marsh was born in Pontiac, Ill., Aug. 6, 1877, and attended the Pontiac schools up to the second year in high school. His family moved to Pana, Ill., in 1894 and Mr. Marsh was graduated from the high school there. He attended the University of Illinois from 1897 to 1901, receiving the degree of B. S. in chemical engineering. For the next two years he was assistant chemist for the Illinois State Water Survey. The following year he worked with an electric storage battery company and then for the next year he devoted his time to technical writing.

During his spare time Mr. Marsh had been experimenting with alloys of nickel and chromium and in 1904 he had developed them to a point where he needed improved facilities and more capital. These he obtained by making a business arrangement with William Hoskins at Chicago to further the commercial development of alloys. Finally in 1908 the Hoskins Manufacturing Company of Detroit was organized. Mr. Marsh at that time served as chief engineer and superintendent, and in 1913 he was made director and general manager.

The Marsh patents controlled the development of many heating applications for several years as the nickel chromium alloys proved very suitable for use as heating elements in baking ovens, irons, ranges, household electric heaters and other devices requiring an incandescent non-oxidizing heating element.

The career of Mr. Marsh furnishes another example of the wonderful contributions to the advancement of the electrical art that are possible through the vision and efforts of an individual research.

# Editorial Comment

Electrical World, July 28, 1923

Volume 82 Number 4

### The Question of Equitable Rates on an Extensive System

THE Supreme Court of the United States has consistently emphasized the fact that a constructive interpretation of law can be had only with due regard to conditions as they exist at the time of the interpretation. There has always been full recognition by this court that no law can be successfully administered in the public interest without a sympathetic realization of the development of society and of the arts. The California Railroad Commission has recently emulated this policy in a decision on the question of rates for an extended electric power system (the Pacific Gas & Electric Company, reviewed in last week's issue of ELECTRICAL WORLD, page 151) and the Supreme Court of Wisconsin could study with profit this particular case, keeping in mind the United States Supreme Court's policy mentioned above. The Wisconsin court's famous condemnation of the so-called "loop system" of rate making is still fresh in mind.

As Professor Marshall, an English economist, has pointed out, while during one decade a certain size of business unit may be best suited for its development, the next decade might so alter conditions as to dictate an entirely different business size. The California commission shows that it has due regard for the present condition in electric system development when it says:

"The fixing of rates and the equitable division of charges on a system as extensive as that of applicant is a problem in the solution of which no exact rule or formula can be used. * * * It is impossible and uneconomical to attempt to fix rates such that each district or each class of consumer will return to the company an equal rate of compensation for the average proportion of the plant necessary for their service. The system is so extensive and receives power from so many points that the service to the different classes of consumers is largely interdependent as to costs."

This opinion from California should serve to help promote sound and equitable rate policies which, in turn, will prove a potent influence in the extension of electric service for the good of the greatest number.

### Forecasting Water Supply

NO OPERATING engineer with a hydro-electric company needs to be told that if he were provided with some accurate method of forecasting water supply he would be able to use the water more economically, he could utilize his plant equipment most efficiently and he could forestall some of the interruptions to service which now seem occasionally inevitable. Three methods are discussed in the N. E. L. A. hydraulic power committee's report this year, namely, by means of precipitation records, by snow surveys and by study of the relation between ocean temperatures and run-off. The last is a new method which deserves the consideration of many companies, as does also the effect of ice coverings on stream flow.

Virtually every one will contend that no cut-and-dried rule can ever be followed for forecasting water supply, but if there shall be a more extensive dissemination of information on how each company is tackling the problem, it will surely serve as a better guide to operation than the haphazard guesses now employed by some organizations.

### Rural Electric Service Not to Be Judged Solely by Money Saved

A PLEA against trying to sell the farmer electric service purely on the basis of its power to save him dollars in his farm-operating costs was made before the North Central Electric Association by Prof. A. E. Stewart of the agricultural department of Minnesota State University. As Professor Stewart pointed out, the biggest single influence in improving living conditions in the city home has been the use of electrical energy for lighting and to do the drudging tasks that sap the energy and vitality of the home worker and the value of the saving thus made is one that cannot be expressed in dollars and cents, nor does any one attempt such a valuation. Professor Stewart claimed for the farmer a right to the same advantages and to the same disregard of what the cost in dollars may be. Incidentally he protested against the idea that the use of electrical energy on the farm must be justified wholly on an economic basis.

This protest reveals anew the confusion that can be created by a loose use of terms. Less than twenty years ago many a banker declared that the farmer or the ordinary citizen could not afford to own an automobile. Its possession meant economic ruin for any one with a personal income less than $10,000 annually. The same solemn warnings have been issued by pessimistic financial geniuses in the past two or three years. Yet the farmer and middle-class American generally are purchasing motor cars at a rate that is astounding, and the ruin that was predicted twenty years ago is still ahead and apparently more remote than ever. There are, no doubt, many people driving motor cars who should not own them, but the fact is that the motor car has so contributed to health, recreational opportunities and all the things that go to make up a more enjoyable life that, in spite of its inevitable misuse, the balance is on the credit side of the ledger. The whole error lies in assuming that the story can be told entirely in the figures on an accountant's balance sheet and that economics is solely a matter of mathematics.

Electricity, the automobile and thousands of other things are adding to the enjoyment of human existence and therefore to the economic advance of the world. It is possible to sit down and prove by figures

that any one of them is a luxury that the world cannot afford. Thus in dollars and cents the use of electric lighting is an economic waste because it costs more than some other forms of light, but the absurdity of the argument is so apparent that it needs no demonstration. Yet there are many electrical men who, while recognizing the intangible benefits of these things and instantly resenting any effort to prove that the use of electric lighting in the city home is a fallacy because it costs more than some other forms of lighting, are consistently applying the same argument to the use of electrical energy on the farm. Electricity in a broad economic sense has advanced the economic status of the world more than any other single agency. Its justification is in intangibles plus dollars saved rather than dollars saved plus intangibles, even though many if not most of its uses are fully justified on the latter basis. The farmer is as much entitled to the benefits that cannot be measured in dollars and cents as any other class in the community, although, like the other classes, he must pay dollars and cents for the benefits. Whatever justification can be shown in dollars and cents makes the total economic showing just that much better. It is like any other business proposition, and, as Professor Stewart pointed out, the value of the intangibles can be made manifest to the farmer just as soon as the seller can convince himself they exist. Since the central-station man is selling these intangibles to other classes every day, he must learn to sell them to the farmer as well.

## The Accountant Must Be Human

IN DISCUSSING "The Value of the Accountant to the Industry" at the recent convention of the N. E. L. A., A. Monro Grier, president of the Canadian Niagara Power Company, assigned a high place to the accountant in the scheme of company organization. He also set a high standard for the accountant to live up to in performing his duties. The engineer has been justly charged with limiting his viewpoint to purely engineering or technical questions and with forgetting the economic and human elements in the solution of his problems, with a result that is often disastrous to himself as well as to the organization to which he belongs. The same type of error can be charged against the accountant in that he has been prone to center his attention upon the technical features of accounting and to ignore the more important human elements. A little of the narrow viewpoint, as previous comment in these columns has pointed out, crept into the discussion of budgeting which followed in the same session that Mr. Grier addressed, when several accountants tried to support the budget as a rigid measure for the control of expenditures, failing to recognize that budget estimates months ahead of detailed study of projects are fallible instruments that need frequent readjustment to be of the greatest value, and that their use as a club eventually makes them valueless because the co-operation of the human element is not obtained.

Louis F. Mussel of the Cities Service Company, in the same session, pointed the way for the accountant when he pleaded for the introduction of this human element and an effort to formulate budgets in terms of the human as well as the dollar assets of the business organization. Dollars, at best, are only a representation of the value of human brain and brawn and are valuable because they put the results of the application and brain and brawn into a fluid state for the most convenient use. To make his work successful the accountant must enlarge his horizon and consider his work and its results in the light of its effect on the human element, the real asset on which the business is built. Cold-blooded recommendations and decisions based on the balance-sheet figures alone make the accountant hated and not loved. He must be human. Accounting, engineering or any of the professions is only the means to an end and not the end itself.

## Mica-Folium Resistant to Internal Ionization

UP TO a certain value of potential gradient most gases are good insulators—air is the commonest and most widely used of all insulating substances. Beyond the critical gradient, however, not only will air not insulate, but in breaking down it spreads destruction and does its best to carry down with it all neighboring insulating structures. The arc in air is the extreme case, the local spark is next, and the ionization of thin layers apparently the least harmful. All of these instances of the breakdown of air are accompanied in varying degrees by elevation of temperature and the liberation of chemically active oxygen and nitrous oxides, highly detrimental to all types of insulation, especially those of fibrous and combustible composition.

Flexible insulation, such as that used in high-voltage cables and turbo-alternator armatures, must from its nature be applied in layers. This means that even under the most careful conditions of manufacture a certain amount of air is introduced between the successive layers. These thin layers of air will break down under a sufficient voltage gradient, and the voltage tends to concentrate on them because of their relatively low specific inductive capacity. The resulting ionization thus tends in various ways to attack the adjacent insulation.

The degree of damage caused by this attack of gaseous ionization has never been exactly known. That it is a real danger is suggested by the evidence in dismantled insulation, of gas pockets with discolored surfaces and other evidences of chemical action. In a paper before the recent A. I. E. E. convention, Dr. J. B. Whitehead described an extensive study of the magnitude and effects of internal ionization in the mica-folium insulation of high-voltage armature conductors. The mechanical properties of mica are especially favorable for the formation of air layers throughout the built-up wall of insulation. The results show the presence of internal ionization, the voltage at which it sets in and other interesting properties. Most important, however, is the fact that the ionization loss is a relatively small part of the total dielectric losses, of which the principal part is due to straight conductivity, and that the resulting deterioration of the body of the insulation is very slow. It is suggested that the great value of mica is in the breaking up of the conductivity inherent in the impregnated fibrous parts of the insulation and in its immunity from attack by the active products of the ionization of the entrapped air layers.

It is a relief to find that by careful manufacture there is one danger the less to armature insulation, but it

must be remembered that the question is still open as regards cables and all other fibrous insulation in which mica cannot be used. Dr. Whitehead's results suggest indirectly that insulation of this type would be subject to attack and depreciate much more rapidly. This is an important question for further experimental study.

## Behavior of Standard Current Transformers Is Assuring

WITH the ever-increasing tendency toward centralization of power generation and expansion of transmission systems the requirements for satisfactory and reliable operation have become more and more rigid and exacting. It follows that the characteristics and properties of the different elements which go to make up the modern high-power systems must be accurately known for normal and abnormal system conditions. This knowledge can be obtained only through the use of measuring devices.

One of the most important of the devices utilized is the current transformer; the accurate metering of the system output is in a large measure dependent on the constancy of its characteristics, while the effective protection of equipment and lines rests upon the ability of the transformer to withstand the abnormal currents to which it may be subjected under system short-circuit conditions.

The behavior of the current transformer under these abnormal conditions is thus of paramount importance. On page 169 are presented some results obtained by actual tests on standard type transformers by the Pennsylvania Water & Power Company. The value of the tests described lies in their being carried out at current values far in excess of the normal rating of the apparatus. A reliable basis is therefore provided for determining the performance of similar equipment wherever installed. These tests are also of value in that they indicate the degree of conservatism of the manufacturer's rating. In general the ratings appear to be well within safe limits.

## Need of Distinguishing Between Polarized and Identified Wiring

JUST now a good deal is heard about "polarized" wiring. But is this exactly the right wording to use, since, as a matter of fact, the present discussion appears to be merely on identifying the grounded conductor and on connecting it to the proper side of the fuse blocks, switches and sockets, rather than on polarizing? It is argued that the grounded or cold conductor is one pole of the circuit and that the "hot" wire is at a different polarity; but polarity, as usually understood, refers not only to a difference of potential but also to the direction or relative value, as positive or negative.

Now, a two-wire system on direct current can be polarized without being grounded at all. To be polarized all that is necessary is that one wire shall always be at the higher potential in relation to the other. On the other hand, there can also be a system which has the grounded conductor identified without the system being polarized, in that the "hot" wire may sometimes be positive and sometimes be negative. This would make a great difference when connecting in order to charge storage batteries, but so long as the same conductor was always connected to ground the fact that the "hot" wire was sometimes positive and sometimes negative would make no difference in the safety factor.

In the case of alternating current the circuits can only be identified as to phases and grounded wire and not for polarity in its usual sense, because the latter is changing continuously. Polarity enters into alternating-current circuits only when it comes to such questions as whether a transformer connection is additive or subtractive. If the polarity of a two-wire direct-current circuit is reversed, any electrolytic effect is, of course, also reversed, even if the same wire is at all times the grounded wire.

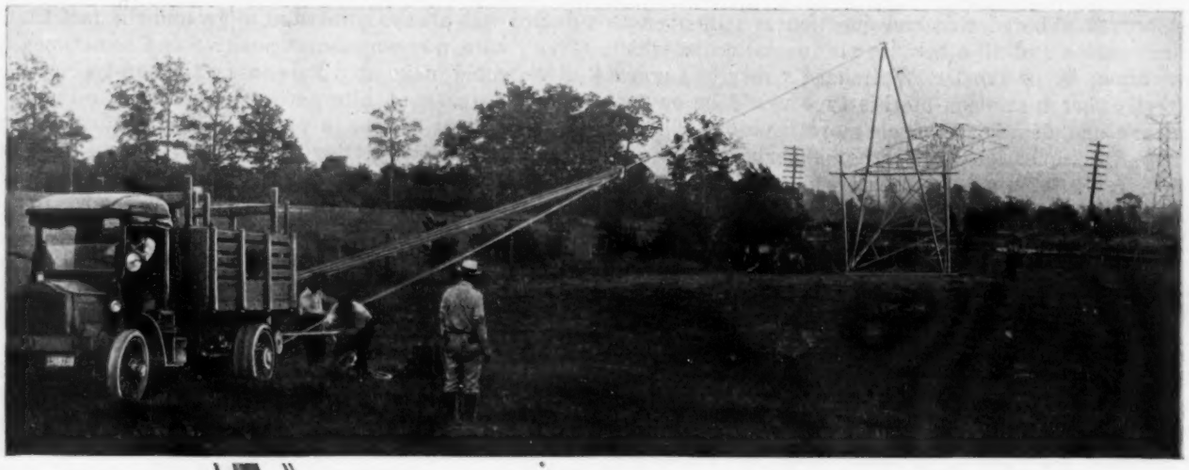
It is suggested that the term "polarized" be reserved for the cases where real polarity is meant and that some other expression be found for the cases where all that is meant is that the grounded wire shall be identified throughout and properly connected. "Polarized" should, of course, mean that one identified wire is always positive or always negative to the other, no matter which is grounded and no matter whether either is grounded. Would not "identified" wiring serve as an expression to indicate that one wire or pole of the circuit is always identified and grounded, irrespective of whether the other pole may either be positive or negative to the grounded pole? If not, will some one suggest a better term?

## Value of Explosion Pots in Oil Circuit Breakers

VERY valuable and interesting data on the operation in actual service of oil circuit breakers are given in Bernard Price's report in this issue relating the experience of South African mining companies with oil circuit breakers equipped and not equipped with explosion chambers. Mr. Price's report is of particular interest to American engineers because it confirms the claims of American switchgear manufacturers. Standard oil circuit breakers utilizing explosion chambers have been marketed for some time in this country. Operating reports that have been made available indicate a performance on such apparatus comparable with the results observed by Mr. Price.

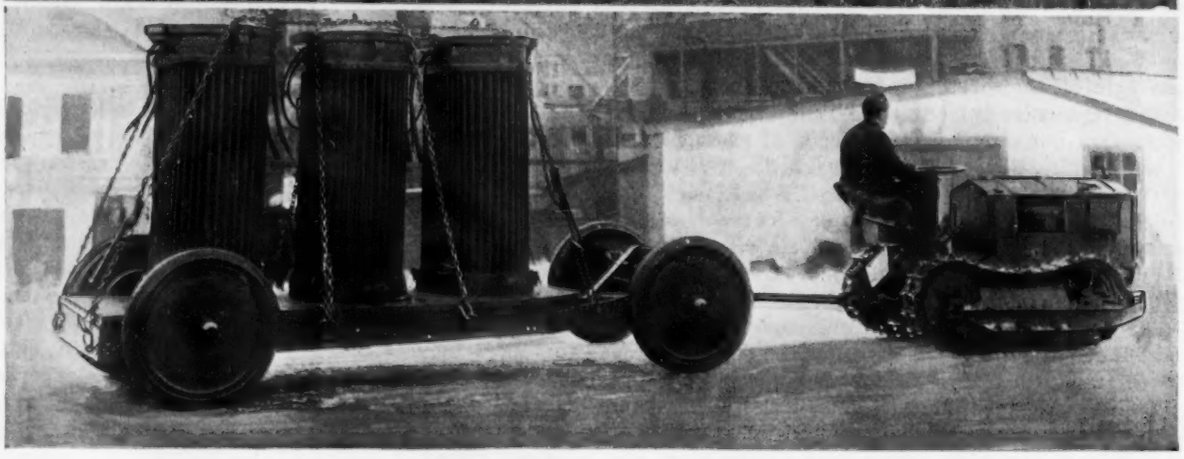
Moreover, a number of operating companies in this country which have found it necessary to increase the interrupting capacity of oil circuit breakers already installed have equipped those breakers with explosion chambers supplied by the original manufacturer of the breaker. Rebuilt breakers so equipped are now in successful operation on 22,000-volt and 110,000-volt circuits. The results obtained in each case warranted the expense of rebuilding.

Mr. Price has indicated that there are a number of design factors involved in the application of explosion chambers to breakers. The determination of the proper oil height, diameter of contact rod, clearance between contact rod and bushing, length of break and other features require considerable experimentation and testing. Inasmuch as such experimentation is generally difficult and expensive to accomplish on a system in commercial service, it would seem that the best practice for operating companies is to refer their problems to the breaker manufacturers, who from their experience in the design of this class of apparatus are able to make definite recommendations for the rebuilding and give definite ratings to the rebuilt equipment.



# Time and Labor Saving Methods

IF THE practices of all companies could be compiled it would be found that they are directing more and more attention to methods of saving time and reducing labor expense in all branches of their activities. Just three applications of mechanical equipment to handling overhead construction work are shown. Many others could be cited. For example, there are truck cranes for loading and hoisting equipment, truck winches for similar purposes, as well as pulling cable, compressed-air drills for installing house-service conduits, compressed-air pavement breakers, trenching machines for laying park cable, etc.



# Tests for Rating Current Transformers

## Effect of High Current on Mechanical Strength—Thermal Capacity Studied—Details of Tests and Conclusions for Specific Types Used on Two Large Atlantic Coast Systems

WHEN current transformers used in connection with relays and meters on power systems undergo short-circuit conditions they are subjected to mechanical forces of considerable magnitude and thermal stresses of great severity. Furthermore, the accuracy of the current transformers for measurement purposes may be questionable under these conditions. To obtain definite information on these points tests were devised and conducted by the Pennsylvania Water & Power Company and the Consolidated Gas, Electric Light & Power Company to determine the thermal or mechanical breakdown limits as well as the accuracy of the devices during the short-circuit period.

In these tests an oscillograph was connected so as automatically to close the oil breaker, thereby imposing a short-circuit current of practically sustained value, and then to open it after a predetermined number of cycles (Fig. 8). The high currents desired were obtained by means of a 5,500-kva., 13,200/169-volt, single-phase furnace transformer at Baltimore energized from either one or two generators at Holtwood through one transmission line and transformers at both ends, or from a generator at Westport through an underground cable. Tests were accordingly made at low voltage, and the currents obtained evidenced very little dying down on account of the high impedance from the generator to the short circuit. The frequency was 25 cycles.

Tests for thermal and mechanical failure were made on the following transformers:

| General Electric Company | Westinghouse Electric & Manufacturing Company |
|---|---|
| K48-100/5 | KB-100/5 |
| K28-300/5 | KB-200/5 |
| D21-300/5 | KB-600/5/5 |
| ..... | Special-100/5 |

Tests for ratio error were made on a Westinghouse FB-2,000/5 and a General Electric D21-300/5 and will be reported in a later issue.

To afford a basis for comparison, calculations were made from test data to establish a two-second rating for each transformer on the following basis:

The quantity of heat $H$ is proportional to the square of the current $I$ (effective), the time $t$, and a constant $K$. Therefore, $H = KI^2t$. Since it is the quantity of heat which destroys the transformer, $H = KI_1^2t_1 = KI_2^2t_2$, or $I_1^2t_1 = I_2^2t_2$, where

$I_1$ = test current in r.m.s. amperes,
$t_1$ = time $I_1$ is present in cycles,
$I_2$ = any other value of current in r.m.s. value,
$t_2$ = time corresponding to $I_2$, in this case 50 cycles, and
$K$ = a constant for a given transformer.

Applying these relations to a specific example, assume the test current as 15,000 r.m.s. amperes and the period before failure 17.5 cycles; then

$15{,}000^2 \times 17.5 = I_1^2 \times 50$, $I = 8{,}880$ r.m.s. amperes, and the transformer would fail for thermal reasons in 50 cycles at 8,880 amp.

Results of the tests to determine the thermal and mechanical limitations of the current transformers are presented below classified as to type:

**K48-100/5.**—This late type of transformer is rated by the maker to withstand momentarily 120 times normal rated full-load current. This was taken to mean that it would withstand this symmetrical effective current plus whatever displacement of the initial wave which may occur on high-voltage short circuit. Assuming a possible displacement of 1.8, the initial peak current will be $120 \times 100 \times 1.8 \times \sqrt{2} = 30{,}600$ amp. The primary is made of a number of turns of square stranded copper wire, and the heavy stranded copper wire secondary is wound on one leg of the core under the primary.

TABLE I—TEST OF TRANSFORMER K48-100/5

Conservative (2-sec.) rating is 8,220 s.e. amp. with old terminals and 10,000 s.e. amp. with new.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycle |
|---|---|---|---|---|---|
| 98 | 11:05 a.m. | 11,700 | 8,750 | 6,180 | 12 |
| 99 | 11:28 a.m. | 15,400 | 11,100 | 7,850 | 17 |
| 100 | 11:31 a.m. | 16,700 | 11,900 | 8,400 | 19 |
| 101 | 11:53 a.m. | 15,600 | 13,600 | 9,600 | 19 |
| 102 | 11:57 a.m. | 17,400 | 16,600 | 11,700 | 19.5 |
| 103 | 11:18 a.m. | 16,300 | 15,800 | 11,100 | 19 |
| 104 | 11:35 a.m. | 20,400 | 18,600 | 13,150 | 19.5 |
| 105 | 11:42 a.m. | 23,300 | 21,200 | 15,000 | 17.5 |
| 106* | 12:02 p.m. | 33,900 | 26,300 | 18,600 | 13.5 |
| 183† | 12:55 p.m. | 30,700 | 24,900 | 17,600 | 19.5† |
| 184‡ | 1:10 p.m. | 31,900 | 59,000 | ..... | 4 |

* New transformer.
† Estimated time.
‡ Transformer of test 106 equipped with extra heavy lugs.

No apparent damage occurred to the transformer up to test No. 105, when one primary terminal burned off and the insulation burst open accompanied by quantities of smoke. Upon opening the transformer the windings were found intact. On the basis of the rating outlined the transformer would fail thermally in 50 cycles at 8,880 amp. Since it withstood a current of 13,150 symmetrical effective amperes for 19.5 cycles, calculations indicate that it would be safe for two seconds at a current of 8,220 symmetrical effective amperes, and if equipped with extra heavy lugs (test No. 183) it should withstand 10,000 symmetrical effective amperes for two seconds. Since (test No. 106) the transformer withstood 33,900 peak amperes, it comes well within the rating claimed, although the lugs burned off after 13.5 cycles. The current value of 59,000 peak amperes on test No. 184 occurred at the fifth half-cycle, and the increase was probably due to the short-circuiting of some of the primary turns when the transformer failed at 31,900 peak amperes. The previous tests probably affected this result, since in test No. 106 it safely withstood 33,900 peak amperes.

**K28-300/5.**—Although no longer cataloged by the maker, this type was tested because several were in use on the system. The first test at 25,600 symmetrical effective amperes for 19.5 cycles is equivalent to 16,000 symmetrical effective amperes for two seconds. No change could be noted in the transformer after this test. It was then tested at an estimated current of 50,000 peak amperes. This test practically destroyed the transformer. The oval-shaped primary attempted to assume a circular form (Figs. 2 and 3). It will be noted that the pieces of angle iron that held the primary in place cut through the primary as it was forced outward. The block of wood that these angle irons supported was thrown a distance of 25 ft. It is believed that this transformer would have caused an arc to form had it been used on high voltage.

A current of 25,600 amp. for 19.5 cycles is equivalent in heat production to 16,000 symmetrical effective amperes for two seconds. The manufacturer rates the instrument at seventy times normal full-load current, which means $70 \times 300 \times \sqrt{2} \times 1.8 = 53{,}400$ peak amperes. It is

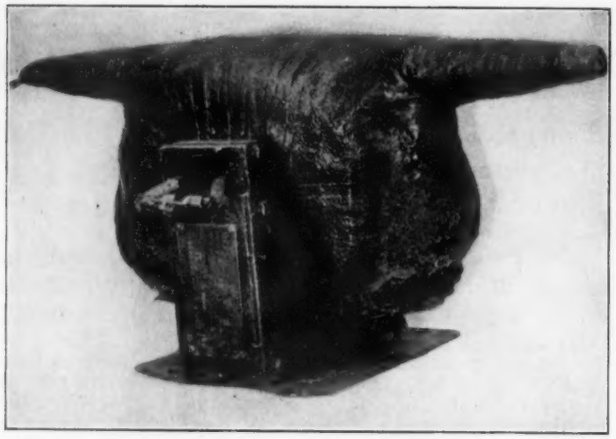
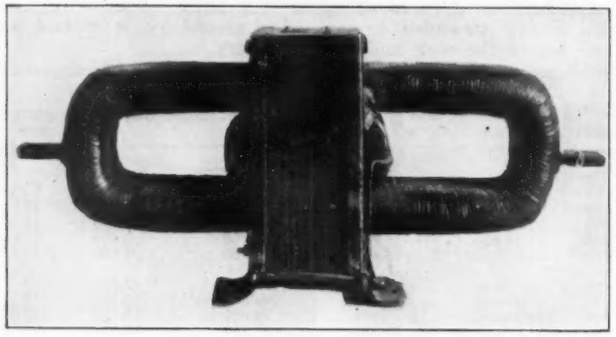
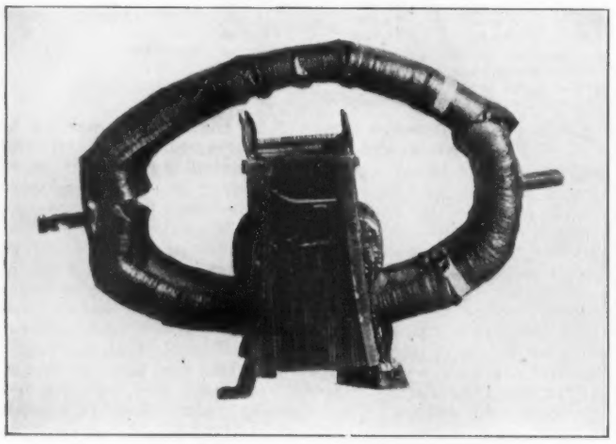


FIG. 1—K48-100/5 AFTER TESTS





FIGS. 2 AND 3—K28-300/5 BEFORE AND AFTER TESTS

believed that this transformer will fail before such a current is reached.

**KB-100/5.**—This transformer is rated by the manufacturer at forty times full load current, or $40 \times 100 \times 1.8 \times \sqrt{2} = 10{,}200$ initial peak amperes.

The first three tests did not injure the transformer as far as could be determined, but the heating was perceptible. The last test, at 20,400 peak amperes (12,600 symmetrical effective amperes), caused the insulation to burst open at the top (Fig. 4). Smoke was emitted from this opening and from the ends of the transformer at the lugs. The oscillogram showed no disturbance to the windings. It is believed that if the three previous tests had not been made, the transformer would have withstood this test successfully. The two-second rating on this assumption would be 7,870 symmetrical effective amperes, and it will be noted that it comes well within the manufacturers' claim of 10,200 initial peak amperes.

**KB-200/5.**—This transformer is the same as the previous one tested except that its ratio is different, and hence its physical dimensions are different.

TABLE II—TEST OF TRANSFORMER K28-300/5

Withstood 25,600 s.e. amp. for 19.5 cycles, but failed mechanically at 50,000 peak amp.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles |
|---|---|---|---|---|---|
| 179 | 3:18 a.m. | 36,200 | 36,200 | 25,600 | 19.5* |
| 180 | 3:37 a.m. | 50,000† | ..... | ..... | |

* Estimated time. † Estimated current.

TABLE III—TEST OF TRANSFORMER KB-100/5

Conservative (2-sec.) rating is 7,870 s.e. amp.; insulation burst open at 12,600 s.e. amp.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles |
|---|---|---|---|---|---|
| 107 | 10:28 a.m. | 13,300 | 10,800 | 7,560 | 19.5* |
| 108 | 11:13 a.m. | 15,300 | 11,600 | 8,200 | 19.5* |
| 109 | 11:18 a.m. | 21,500 | 14,700 | 10,400 | 19.5* |
| 110 | 11:25 a.m. | 20,400 | 17,900 | 12,600 | 19.5* |

* Estimated time.

The manufacturers' momentary rating would be $40 \times 200 \times 2 \times 1.8 = 20{,}400$ initial peak amperes.

On the first test the only effect noted was the heating of the transformer accompanied by the emission of quantities of smoke. After an interval of several days, giving the transformer time to cool, it was tested at an initial current of 66,000 peak amperes. It soon dropped to a sustained value of 43,300 effective amperes, and, after 11 cycles, it blew open and caught fire (Fig. 5). Considerable noise accompanied the opening and the primary winding was ruptured.

The two-second rating based on test No. 182 is 17,600 symmetrical effective amperes. This same test again shows that the manufacturers' momentary rating of 20,400 initial peak amperes is conservative. Here again this rating would be doubled and the transformer still be safe.

**D21-300/5**—The test at 15,800 effective amperes had no noticeable effect on the transformer either mechanically or thermally. The second test at 24,500 effective amperes resulted in the burning off of one of the terminals after 18½ cycles. After replacing the burned-off terminal with a standard cable terminal another test was made at an effective current of 29,700 effective amperes. This test resulted in the other terminal burning off after 11.5 cycles, but there was no other mechanical or thermal effect on the transformer aside from its becoming quite warm.

The second terminal which burned off was also replaced with a cable terminal, and a fourth test was made on the transformer at an effective current of 31,600 effective amperes. This caused the transformer to fail thermally. Large volumes of smoke were emitted from both ends and the compound was melted (Fig. 6), permitting the cone-shaped ends to separate from the cylindrical part. Examination of the transformer after this test showed that a number of the primary strands had fused and the turns had short-circuited in the center of the core.

The highest peak current of 54,300 amp. had no noticeable mechanical effect on the transformer. This corresponds to $54{,}300 \div \sqrt{2} \times 1.8 = 21{,}300$ effective symmetrical amperes. The manufacturer's rating of $70 \times 300 \times \sqrt{2} \times 1.8 = 53{,}400$ peak amperes is also less than the peak value actually obtained, which gave no mechanical damage to the transformer.

The tests showed that the terminals burned off before the transformer itself failed thermally. With the old terminals, then, the two-second safe rating based on the first test would be only:

$$\sqrt{\frac{15.800^2 \times 20.5}{50}} = 10{,}100 \text{ amp. (effective)}.$$

However, with new terminals the transformer can be safely rated on a two-second basis at:

$$\sqrt{\frac{24{,}500^2 \times 18.5}{50}} = 14{,}900 \text{ amp. (effective)}.$$

In all the above tests the currents were practically of sustained value. The short-circuit currents under actual service conditions, however, are usually not sustained but have considerable attenuation due to the demagnetizing action of the generator fields. It was desirable to determine the corresponding time for failure under the short circuit obtained under service con-

TABLE IV—TEST OF TRANSFORMER KB-200/5

Heated up and emitted smoke on first test; with 43,000 s.e. amp. for 11 cycles it blew open and caught fire.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles |
|---|---|---|---|---|---|
| 182 | 2:58 a.m. | 48,800 | 39,800 | 28,100 | 19.5* |
| 185 | 1:35 a.m. | 66,000 | 61,400 | 43,300 | 11 |

* Estimated time.

TABLE V—TEST OF TRANSFORMER D21-300/5

Has conservative rating of 10,100 s.e. amp. with old terminals and 14,900 amp. with new.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles | Result of Test |
|---|---|---|---|---|---|---|
| 217 | 1:25 a.m. | 31,400 | 22,400 | 15,800 | 20.5 | No effect |
| 218 | 2:30 a.m. | 53,800 | 34,600 | 24,500 | 18.5 | Terminal burned off |
| 223 | 1:22 a.m. | 49,000 | 42,000 | 29,700 | 11.5 | Terminal burned off |
| 229 | 1:50 a.m. | 54,300 | 44,900 | 31,600 | 21.5 | Primary short-circuited; smoked badly. |

TABLE VI—TEST OF SPECIAL 100/5 TRANSFORMER

Suitable for 9,700 s.e. amp. for 2 sec.; primary short circuited at 18,300 s.e. amp. after 15 cycles.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles | Result of Test |
|---|---|---|---|---|---|---|
| 215 | 3:40 a.m. | 35,000* | 21,200* | 15,000* | 21 | No effect |
| 216 | 3:50 a.m. | 45,000* | 25,800* | 18,300* | 22.5 | Primary short-circuited: smoke and flame emitted from small hole. |

* Estimated.

ditions of 17,530 amp. initial and 7,360 amp. final. Something proportional to the total heat input under the test currents can be obtained by squaring the current and multiplying the result by the time in cycles (amperes$^2$ × cycles). The corresponding time for failure under actual conditions of short circuit is then obtained from a curve (Fig. 7) which gives amperes$^2$ × cycles for the above short-circuit currents obtained in service (radiation neglected).

From the results of test 223, which is the worst case, the terminals would be expected to burn off in service in not less than 3.9 seconds. However, it must be borne in mind that the terminal which burned off in test No. 223 previously withstood more current in test 218 without failure. The first terminal which burned off, according to the above calculations, would have required 5.3 seconds to burn off in service. It thus seems that the terminal which failed in test No. 223 may have been injured to some extent in the previous test.

However, even in the worst case, where 3.9 seconds would be required to burn the terminals off in service, there seems to be sufficient factor of safety to justify their use with the old terminals.

**KB-600/5/5.**—In tests Nos. 208-213 there was no noticeable effect either mechanically or thermally on this type of current transformer. However, on the last test, No. 214, a small amount of smoke was emitted from around one terminal. According to the oscillogram there was no internal damage. Inasmuch as the transformer withstood safely 41,300 effective amperes for 22 cycles, the two-second ratings would be 27,400 effective amperes. The highest peak amperage obtained without any mechanical damage was 90,000. This corresponds to 35.400 symmetrical effective amperes for the mechanical rating.

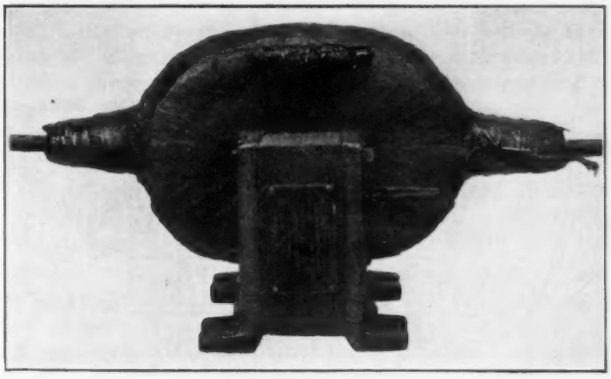


FIG. 4—KB-100/5

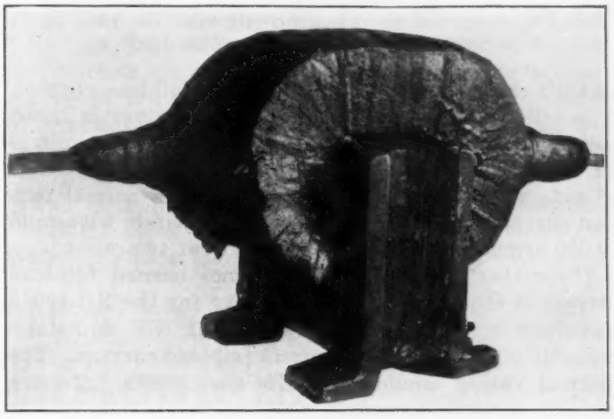


FIG. 5—KB-200/5

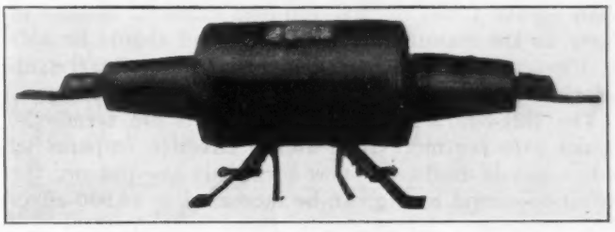


FIG. 6—D21-300/5

The manufacturer's rating of 40 × 600 × √2 × 1.8 = 61,000 is thus very conservative.

**"Special" 100/5.**—This transformer was built with strong mechanical bracing, consisting of an angle-iron brace around the whole transformer, and in addition it was designed for high thermal capacity.

The first test, at 15,000 effective amperes, had no effect whatever on the transformer either mechanically or thermally, and no heating was perceptible after the test.

The second test, at 18,300 effective amperes, resulted in a thermal failure of the transformer. Flame and smoke were emitted from a small hole near the terminal, and some of the compound melted and ran out. The oscillogram indicated that the primary turns short-circuited after 15 cycles, and examination after the test confirmed this fact.

The tests showed that the transformer withstood 15,000 amp. for 21 cycles without any damage. Its safe two-second thermal rating then would be 9,700 effective amperes. The estimated peak amperage which this transformer withstood safely is 45,000. This corresponds to a symmetrical effective current of 17,700 amp. for a mechanical rating.

The K48-100/5 transformer comes within the manufacturer's claim of 120 times normal full-load current momentarily. It would be considerably improved if the primary lugs were much heavier. As it stands its thermal rating would be 8,220 amp. for two seconds.

The K28-300/5 transformer does not come within the

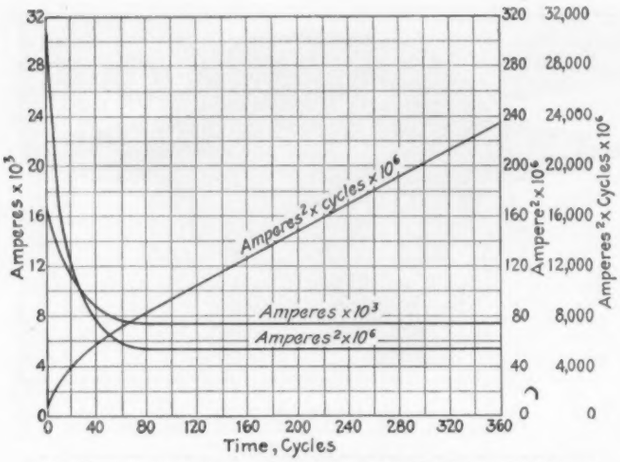



FIG. 7—CURVE FOR DETERMINING THE TIME FOR FAILURE UNDER SERVICE CONDITIONS

maker's claim of seventy times normal full-load current, it is believed. The design of the transformer is incorrect, for the primary is oval and tends to become circular when subjected to heavy currents. It is believed to be safe at forty-seven and one-half times normal full-load current. It is believed that it will safely withstand 16,000 symmetrical effective amperes for two seconds.

The maker's rating of forty times normal full-load current is thought to be conservative for the KB-100/5 transformer. The tests show that it will withstand probably eighty times the normal full-load current. The thermal rating would be 7,870 symmetrical effective amperes for two seconds.

As should be expected from the previous tests, the KB-200/5 transformer was found to stand up to more than eighty times normal full-load current, instead of forty as the manufacturer claimed, and should be safe at these currents. The thermal rating is 17,600 symmetrical effective amperes for two seconds.

The D21-300/5 transformer, with its old terminals, is not safe for more than 10,100 effective amperes on a two-second basis. If new terminals are put on, the safe two-second rating can be increased to 14,900 effective amperes. Mechanically these transformers are sufficiently strong for the service intended, and they also come within the manufacturer's rating.

Mechanically the KB-600/5/5 transformer is well

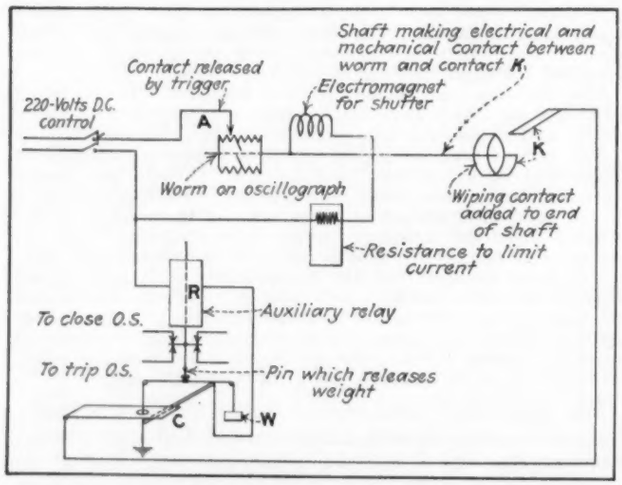



FIG. 8—THE OIL BREAKER MADE AND OPENED THE SHORT CIRCUIT AFTER A PREDETERMINED NUMBER OF CYCLES

TABLE VII—TEST OF TRANSFORMER KB-600/5

Two-second rating is 27,400 s.e. amp.; 46,000 amp. after 23.5 cycles caused small amount of smoke to be emitted around terminal.

| Test No. | Time | Initial Peak Amperes | Symmetrical Peak Amperes | Symmetrical Effective Amperes | Cycles | Result of Test |
|---|---|---|---|---|---|---|
| 208 | 1:55 a.m. | 32,400 | 25,900 | 18,300 | 21.5 | No effect |
| 209 | 2:44 a.m. | 45,000 | 38,700 | 27,400 | 17+1 | No effect |
| 210 | 3:55 a.m. | 59,800 | 46,100 | 32,600 | 21.5 | No effect |
| 211 | 4:03 a.m. | 69,100 | 49,500 | 35,100 | 22.5 | No effect |
| 212 | 4:45 a.m. | 80,000 | 54,700 | 38,700 | 23.0 | No effect |
| 213 | 1:25 a.m. | 75,000* | 58,500* | 41,300* | 22.0 | No effect |
| 214 | 2:00 a.m. | 90,000* | 66,200* | 46,900* | 23.5 | Small amount of smoke emitted from around one terminal |

* Estimated.

within the manufacturer's rating. The two-second rating is 27,400 effective amperes.

The tests showed that the two-second safe rating of the "special" 100/5 transformer is 9,700 effective amperes. Tests on the KB-100/5 transformer showed that its two-second safe rating was 7,870 effective amperes. The manufacturer's claim of a higher thermal capacity is thus substantiated, there having been an increase of approximately 23 per cent. The "special" transformer also was subjected to a somewhat higher peak ampere than the KB-100/5 transformer, without any mechanical injury. However, there was no mechanical failure of the KB-100/5, so that it is difficult to say whether or not it is stronger mechanically, although it is reasonable to think that with the added bracing around it it is.

The tests tend to confirm the experience of the operating companies making these tests and indicate their present practice to be in the proper direction with a reasonable margin of safety. Where the smaller sizes of current transformers must be used in locations of possible high short-circuit currents, special attention should be given to have transformers of proper or even special design, or other precautions should be taken. Thus where current transformers of small ratings are desirable for metering purposes but might be danger-

TABLE VIII—SUMMARY OF TESTS

| Transformer | Ratio | Maker's Rating, in Initial Peak Amp. | Test Current Without Mechanical Injury, in Initial Peak Amp. | Two-Second Rating (Safe), in Symmetrical Effective Amp. | Actual Current Which Destroyed Transformer, in Symmetrical Effective Amp. | Corresponding Time in Cycles | Cause of Failure in Previous Column |
|---|---|---|---|---|---|---|---|
| K-48 | 100/5 | 30,600 | 33,900 | 8,220 | 15,000 | 17.5 | Terminal burned off |
| K-28 | 300/5 | 53,400 | 36,200 | 16,000 | Approx. 35,000 | Probably in a few cycles | Primary blown in form of circle |
| KB | 100/5 | 10,200 | 21,500 | 7,870 | 12,600 | 19.5* | Insulation burst open; smoked badly |
| KB | 200/5 | 20,400 | 48,800 | 17,600 | 43,300 | 11 | Primary burned open; transformer caught fire |
| D-21 | 300/5 | 53,400 | 54,300 | 10,100 | 24,500 | 18.5 | Terminal burned off |
| K-B | 600/5/5 | 61,000 | 90,000 | 27,400 | 46,900 | 23.5 | Smoke emitted from around terminal |
| "Special" | 100/5 | Not known | 45,000 | 9,700 | 18,300 | 22.5 | Primary turns short-circuited |

* Estimated.

ously located in case of short circuits, the Pennsylvania Water & Power Company has followed the practice of either protecting all the equipment, including the current transformers, by insertion of reactors or resistors on the high side between the bus and the equipment to be protected or using current transformers of larger rating for relay purposes in series with the smaller ones used for metering purposes, thus accepting the eventual destruction of the latter but relying on the former for clearing the short.

An important point brought out by these tests is the thermal effect. The destructive effect of magnetic stresses in current transformers seems to be well recognized, but the thermal effects under abnormal currents have probably not been so well appreciated. The melting of lugs and windings produces destructive effects sometimes in excess of those caused by magnetic stresses. Both the magnetic and thermal effects on a given transformer are proportional to the square of the current, but with this important difference—that if the transformer withstands the first initial (displaced) wave it will not be destroyed mechanically, but may fail a little later owing to the cumulative effect of the heating. Current transformers of larger rating but the same design will have proportionally fewer primary turns and will, therefore, both mechanically and thermally, withstand higher currents directly in proportion to their size. If used at a place where a given maximum short-circuit current obtains, the effect of replacing a smaller current transformer with a larger one, on the other hand, will be to increase the safety factor proportionately with the square of the current.

Tests and actual experience indicate that it should be possible for the manufacturer to build a commercial transformer of reasonable magnetic strength at a reasonable cost. However, considering all factors, magnetic and thermal stresses, accuracy and costs, the problem is more involved. It may be of easy solution in the larger sizes, but perhaps not in the smaller sizes, where special and more expensive transformers might be required for points of large capacity. On the other hand, the operating companies should carefully study each application and balance the various factors involved. It is important to have complete knowledge of current-transformer applications, and it seems desirable that a survey of the system should be made with the object of determining just what current transformers are safe and just what are unsafe, based on the possible short circuits obtaining at those points.

The foregoing information is based on data furnished by J. E. Allen, chief of tests with the Pennsylvania Water & Power Company.

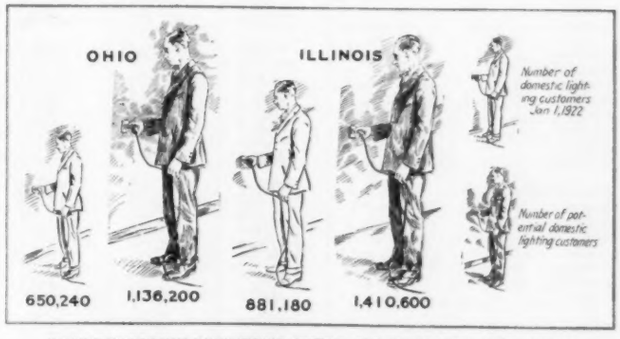
# Potential Customers in Ohio and Illinois Total 3,123,000

## "Electrical World's" Estimate of Present and Potential Customers in Ohio and Illinois by Counties Indicates that a Total of About 1,015,380 Homes Are Possible of Future Electrification

CONTINUING its study of the distribution of present and potential central-station customers in the counties of the various states, the ELECTRICAL WORLD presents in the accompanying tables its estimate of the consumers in the counties of Ohio and Illinois. Studies have previously been made for New England and the Middle Atlantic States, and the results were published in the issues of April 28 and June 16, 1923, respectively. Similar data for other states of the Union will appear in early isues of the ELECTRICAL WORLD.

This study is based upon reports which have been received by the ELECTRICAL WORLD from operating companies representing about 70 per cent of the installed generator rating of the country, supplemented by data on population and industrial power issued by the United States Census Bureau. The data obtained in this way were referred to a representative company operating in the county concerned with the request that an opinion be given as to whether the data represent with a fair degree of accuracy existent conditions in that county.

In the few cases where the operating companies to which the figures were sent indicated that the ELECTRICAL WORLD'S figures were at variance with conditions in the county a new study was made and the data were corrected accordingly. The figures of the various counties, while estimates, are believed to indicate very clearly the present and future potentialities of the counties as ultimate purchasers of electrical apparatus, appliances and supplies.




THE DOMESTIC LIGHTING FIELD IN ILLINOIS AND OHIO IS ABOUT 60 PER CENT DEVELOPED

The method used in determining the number of potential residential-lighting customers, potential commercial-lighting customers and potential industrial-power customers was adopted after careful study. To arrive at the number of potential domestic-lighting customers of any county it was assumed that all of the families residing in the urban districts of that county fall within this category. It was also assumed that all

the families residing in rural towns are potential domestic-lighting customers and that 50 per cent of the remaining families in rural districts are potential customers. Adding these three quantities gives the total potential domestic-lighting customers of that county.

## Present and Potential Central-Station Customers in Ohio by Counties

| County | Population (Census of 1920) | | | Domestic Lighting Customers | | Commercial Lighting Customers | | Industrial Power Customers | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Urban* | Rural | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including) Present Customers |
| **TOTALS FOR OHIO** | 5,759,394 | 3,915,235 | 1,844,159 | 650,240 | 1,136,200 | 102,450 | 179,910 | 26,360 | 58,000 |
| Adams | 22,403 | 2,832 | 19,571 | 720 | 2,140 | 90 | 270 | 30 | 150 |
| Allen | 68,223 | 47,988 | 20,235 | 8,250 | 13,490 | 1,400 | 2,280 | 330 | 340 |
| Ashland | 24,627 | 11,136 | 13,491 | 2,200 | 5,200 | 450 | 600 | 90 | 180 |
| Ashtabula | 65,545 | 36,038 | 29,507 | 5,080 | 11,240 | 890 | 1,970 | 150 | 670 |
| Athens | 50,430 | 19,400 | 31,030 | 3,930 | 6,990 | 440 | 1,160 | 200 | 400 |
| Auglaize | 29,527 | 14,014 | 15,513 | 2,110 | 4,800 | 370 | 840 | 50 | 250 |
| Belmont | 93,193 | 42,390 | 50,803 | 5,900 | 13,560 | 1,110 | 2,550 | 170 | 950 |
| Brown | 22,621 | 3,199 | 19,422 | 840 | 2,400 | 110 | 310 | 30 | 150 |
| Butler | 87,025 | 65,415 | 21,610 | 8,470 | 17,680 | 1,600 | 3,340 | 120 | 1,190 |
| Carroll | 15,942 | 3,299 | 12,643 | 750 | 1,930 | 110 | 280 | 20 | 40 |
| Champaign | 25,071 | 10,317 | 14,754 | 1,940 | 4,410 | 300 | 680 | 40 | 80 |
| Clark | 80,725 | 63,126 | 17,599 | 8,470 | 17,520 | 1,560 | 2,000 | 710 | 800 |
| Clermont | 28,291 | 6,613 | 21,678 | 1,440 | 3,680 | 200 | 510 | 30 | 60 |
| Clinton | 23,036 | 8,212 | 14,824 | 2,110 | 3,850 | 490 | 720 | 120 | 150 |
| Columbiana | 83,131 | 56,930 | 26,201 | 7,530 | 16,010 | 1,380 | 2,930 | 290 | 830 |
| Coshocton | 29,595 | 10,847 | 18,748 | 2,480 | 4,000 | 210 | 450 | 140 | 300 |
| Crawford | 36,054 | 22,112 | 13,942 | 3,230 | 6,970 | 560 | 1,210 | 210 | 540 |
| Cuyahoga | 943,495 | 919,994 | 23,501 | 188,400 | 216,320 | 20,540 | 23,000 | 5,000 | 5,200 |
| Darke | 42,911 | 11,512 | 31,399 | 3,000 | 5,730 | 700 | 1,340 | 400 | 700 |
| Defiance | 24,549 | 11,254 | 13,295 | 2,000 | 4,210 | 340 | 710 | 110 | 200 |
| Delaware | 26,013 | 8,756 | 17,257 | 1,680 | 3,950 | 260 | 610 | 40 | 200 |
| Erie | 39,789 | 26,036 | 13,753 | 3,750 | 7,980 | 670 | 1,430 | 300 | 800 |
| Fairfield | 40,484 | 14,706 | 25,778 | 2,520 | 5,910 | 420 | 990 | 110 | 350 |
| Fayette | 21,518 | 0 | 21,518 | 540 | 1,850 | 50 | 170 | 20 | 40 |
| Franklin | 283,951 | 245,097 | 38,854 | 30,750 | 63,780 | 5,860 | 12,160 | 1,880 | 3,870 |
| Fulton | 23,445 | 6,951 | 16,494 | 1,350 | 3,290 | 200 | 490 | 30 | 150 |
| Gallia | 23,311 | 6,070 | 17,241 | 930 | 2,460 | 150 | 400 | 20 | 100 |
| Geauga | 15,036 | 1,566 | 13,470 | 540 | 1,570 | 70 | 200 | 10 | 50 |
| Greene | 31,221 | 13,500 | 17,721 | 2,840 | 5,130 | 750 | 860 | 127 | 150 |
| Guernsey | 45,352 | 15,879 | 29,473 | 2,360 | 5,740 | 400 | 970 | 20 | 330 |
| Hamilton | 493,678 | 470,634 | 23,044 | 59,800 | 124,840 | 11,900 | 24,900 | 4,550 | 11,900 |
| Hancock | 38,394 | 19,691 | 18,703 | 3,320 | 7,260 | 550 | 1,210 | 200 | 470 |
| Hardin | 29,167 | 11,154 | 18,013 | 1,950 | 4,560 | 310 | 730 | 40 | 200 |
| Harrison | 19,625 | 2,084 | 17,541 | 590 | 1,820 | 70 | 220 | 30 | 150 |
| Henry | 23,362 | 6,696 | 16,666 | 1,200 | 3,150 | 220 | 510 | 30 | 130 |
| Highland | 27,610 | 8,700 | 18,910 | 1,690 | 4,090 | 250 | 610 | 50 | 250 |
| Hocking | 23,291 | 6,986 | 16,305 | 1,070 | 2,600 | 170 | 410 | 20 | 100 |
| Holmes | 16,965 | 2,098 | 14,867 | 490 | 1,810 | 60 | 220 | 30 | 150 |
| Huron | 32,424 | 17,490 | 14,934 | 2,790 | 6,420 | 460 | 1,060 | 60 | 300 |
| Jackson | 27,342 | 13,923 | 13,419 | 1,640 | 4,090 | 300 | 750 | 40 | 200 |
| Jefferson | 77,580 | 45,234 | 32,346 | 5,620 | 12,550 | 1,150 | 2,570 | 120 | 440 |
| Knox | 29,580 | 10,431 | 19,149 | 1,860 | 4,470 | 280 | 670 | 30 | 150 |
| Lake | 28,667 | 15,647 | 13,020 | 1,490 | 4,830 | 260 | 840 | 30 | 150 |
| Lawrence | 39,540 | 15,858 | 23,682 | 1,830 | 4,820 | 340 | 890 | 90 | 310 |
| Licking | 56,426 | 29,816 | 26,610 | 4,790 | 10,560 | 780 | 1,720 | 280 | 600 |
| Logan | 30,104 | 10,683 | 19,421 | 2,330 | 5,250 | 370 | 830 | 50 | 250 |
| Lorain | 90,612 | 68,195 | 22,417 | 8,370 | 20,000 | 1,660 | 3,520 | 220 | 990 |
| Lucas | 275,721 | 247,581 | 28,140 | 29,510 | 60,670 | 5,950 | 12,230 | 2,230 | 3,800 |
| Madison | 19,662 | 6,363 | 13,299 | 1,400 | 2,980 | 220 | 470 | 20 | 100 |
| Mahoning | 186,310 | 155,197 | 31,113 | 22,500 | 49,000 | 3,800 | 5,500 | 150 | 200 |
| Marion | 42,004 | 27,891 | 14,113 | 5,200 | 11,000 | 900 | 1,500 | 250 | 450 |
| Medina | 26,067 | 9,412 | 16,655 | 2,920 | 3,870 | 460 | 610 | 60 | 300 |
| Meigs | 26,189 | 8,066 | 18,123 | 1,270 | 3,220 | 190 | 480 | 20 | 100 |
| Mercer | 26,872 | 7,924 | 18,948 | 1,230 | 3,060 | 220 | 550 | 40 | 200 |
| Miami | 48,428 | 29,374 | 19,054 | 4,940 | 10,600 | 770 | 1,650 | 250 | 690 |
| Monroe | 20,660 | 2,394 | 18,266 | 500 | 1,670 | 60 | 200 | 30 | 150 |
| Montgomery | 209,532 | 163,008 | 46,534 | 36,830 | 43,400 | 4,870 | 6,700 | 1,520 | 2,400 |
| Morgan | 14,555 | 1,618 | 12,937 | 610 | 1,490 | 60 | 150 | 20 | 200 |
| Morrow | 15,570 | 2,946 | 12,624 | 310 | 1,730 | 40 | 200 | 20 | 200 |
| Muskingum | 57,980 | 33,112 | 24,868 | 4,770 | 10,990 | 800 | 1,850 | 180 | 640 |
| Noble | 17,849 | 2,756 | 15,093 | 410 | 1,610 | 40 | 160 | 20 | 100 |
| Ottawa | 22,193 | 6,834 | 15,359 | 1,460 | 3,350 | 250 | 570 | 30 | 150 |
| Paulding | 18,736 | 3,169 | 15,567 | 840 | 2,150 | 130 | 330 | 20 | 100 |
| Perry | 36,098 | 13,561 | 22,537 | 2,090 | 4,930 | 370 | 870 | 30 | 150 |
| Pickaway | 25,788 | 8,081 | 17,707 | 1,330 | 3,270 | 220 | 540 | 30 | 150 |
| Pike | 14,151 | 1,625 | 12,526 | 340 | 1,130 | 40 | 130 | 10 | 50 |
| Portage | 36,269 | 15,408 | 20,861 | 2,490 | 5,690 | 420 | 960 | 60 | 300 |
| Preble | 23,238 | 4,313 | 18,925 | 1,520 | 4,010 | 230 | 610 | 40 | 200 |
| Putnam | 27,751 | 6,816 | 20,935 | 1,500 | 3,800 | 250 | 630 | 40 | 200 |
| Richland | 55,178 | 33,402 | 21,776 | 4,940 | 10,570 | 900 | 1,920 | 430 | 780 |
| Ross | 41,556 | 15,831 | 25,725 | 2,470 | 5,820 | 430 | 1,010 | 10 | 230 |
| Sandusky | 37,109 | 19,513 | 17,596 | 2,870 | 6,430 | 480 | 1,080 | 210 | 430 |
| Scioto | 62,850 | 44,827 | 18,023 | 4,640 | 11,480 | 920 | 2,280 | 40 | 430 |
| Seneca | 43,176 | 22,704 | 20,472 | 3,510 | 7,740 | 600 | 1,330 | 190 | 620 |
| Shelby | 25,923 | 8,590 | 17,333 | 2,500 | 4,110 | 350 | 580 | 150 | 300 |
| Stark | 177,218 | 133,323 | 43,895 | 31,860 | 47,500 | 6,130 | 8,200 | 1,590 | 3,250 |
| Summit | 286,065 | 252,263 | 33,802 | 38,500 | 57,400 | 6,730 | 8,500 | 1,200 | 1,800 |
| Trumbull | 83,920 | 51,106 | 32,814 | 6,610 | 14,310 | 1,260 | 2,730 | 210 | 830 |
| Tuscarawas | 63,578 | 34,160 | 29,418 | 5,150 | 11,170 | 950 | 2,060 | 130 | 690 |
| Union | 20,918 | 5,236 | 15,682 | 1,150 | 3,270 | 170 | 480 | 20 | 100 |
| Van Wert | 28,210 | 10,676 | 17,534 | 1,960 | 4,760 | 340 | 830 | 30 | 150 |
| Vinton | 12,075 | 1,307 | 10,768 | 290 | 960 | 30 | 100 | 10 | 50 |
| Warren | 25,716 | 6,467 | 19,249 | 1,530 | 3,670 | 230 | 550 | 40 | 200 |
| Washington | 43,049 | 16,457 | 26,592 | 2,590 | 6,150 | 420 | 1,000 | 190 | 450 |
| Wayne | 41,346 | 16,245 | 25,101 | 2,790 | 6,440 | 460 | 1,060 | 70 | 350 |
| Williams | 24,627 | 8,318 | 16,309 | 1,930 | 4,360 | 300 | 680 | 40 | 200 |
| Wood | 44,892 | 10,656 | 34,236 | 2,770 | 6,550 | 450 | 1,070 | 40 | 200 |
| Wyandot | 19,481 | 6,196 | 13,285 | 1,270 | 2,980 | 200 | 470 | 30 | 150 |

* Cities and towns of over 1,000 population.

## Present and Potential Central-Station Customers in Illinois by Counties

| County | Population (Census of 1920) | | | Domestic Lighting Customers | | Commercial Lighting Customers | | Industrial Power Customers | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Urban* | Rural | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including Present Customers) | Total (Jan. 1, 1922) | Total Potential (Including) Present Customers |
| **TOTALS FOR ILLINOIS** | 6,485,280 | 4,756,462 | 1,728,818 | 881,180 | 1,410,600 | 171,380 | 289,970 | 27,250 | 48,740 |
| Adams | 62,188 | 37,016 | 25,172 | 8,100 | 13,080 | 1,380 | 2,220 | 220 | 490 |
| Alexander | 23,980 | 15,203 | 8,777 | 3,080 | 5,860 | 520 | 990 | 40 | 160 |
| Bond | 16,045 | 3,091 | 12,954 | 1,270 | 2,750 | 180 | 390 | 10 | 30 |
| Boone | 15,322 | 7,804 | 7,518 | 1,910 | 3,200 | 310 | 520 | 10 | 40 |
| Brown | 9,336 | 1,932 | 7,404 | 890 | 1,690 | 100 | 190 | 10 | 30 |
| Bureau | 42,648 | 16,352 | 26,296 | 5,140 | 8,500 | 920 | 1,520 | 20 | 80 |
| Calhoun | 8,245 | 0 | 8,245 | 310 | 1,510 | 20 | 100 | 10 | 30 |
| Carroll | 19,345 | 8,340 | 11,005 | 2,620 | 4,370 | 380 | 630 | 130 | 150 |
| Cass | 17,896 | 9,734 | 8,162 | 2,320 | 3,790 | 270 | 440 | 10 | 10 |
| Champaign | 56,959 | 27,668 | 29,291 | 6,960 | 11,440 | 1,210 | 1,990 | 350 | 480 |
| Christian | 38,458 | 17,877 | 20,581 | 4,300 | 7,390 | 730 | 1,260 | 10 | 40 |
| Clark | 21,165 | 5,848 | 15,317 | 2,440 | 4,690 | 230 | 440 | 10 | 60 |
| Clay | 17,684 | 3,558 | 14,126 | 1,320 | 2,890 | 190 | 420 | 10 | 50 |
| Clinton | 22,947 | 8,329 | 14,618 | 1,900 | 4,000 | 330 | 700 | 20 | 80 |
| Coles | 35,108 | 21,377 | 13,731 | 4,530 | 7,310 | 770 | 1,240 | 120 | 280 |
| Cook | 3,053,017 | 2,993,620 | 59,397 | 490,050 | 742,000 | 101,670 | 168,200 | 20,420 | 33,300 |
| Crawford | 22,771 | 6,715 | 16,056 | 1,650 | 3,670 | 240 | 530 | 10 | 60 |
| Cumberland | 12,858 | 2,379 | 10,479 | 830 | 2,000 | 110 | 270 | 10 | 10 |
| De Kalb | 31,339 | 15,110 | 16,229 | 3,970 | 6,690 | 650 | 1,090 | 20 | 100 |
| DeWitt | 19,252 | 7,576 | 11,676 | 2,000 | 3,680 | 310 | 570 | 10 | 40 |
| Douglas | 19,604 | 8,113 | 11,491 | 2,140 | 3,800 | 350 | 620 | 10 | 40 |
| Du Page | 42,120 | 25,464 | 16,656 | 5,050 | 8,140 | 940 | 1,510 | 30 | 130 |
| Edgar | 25,769 | 9,086 | 16,683 | 2,670 | 4,950 | 410 | 760 | 20 | 90 |
| Edwards | 9,431 | 1,584 | 7,847 | 930 | 1,780 | 140 | 270 | 20 | 40 |
| Effingham | 19,556 | 5,376 | 14,180 | 1,430 | 3,080 | 220 | 470 | 10 | 60 |
| Fayette | 26,187 | 4,653 | 21,534 | 1,450 | 3,750 | 190 | 490 | 10 | 50 |
| Ford | 16,466 | 5,267 | 11,199 | 1,570 | 3,010 | 260 | 500 | 10 | 40 |
| Franklin | 57,293 | 35,814 | 21,479 | 6,160 | 10,730 | 1,210 | 2,100 | 10 | 50 |
| Fulton | 48,163 | 20,926 | 27,237 | 5,630 | 9,650 | 920 | 1,570 | 10 | 60 |
| Gallatin | 12,856 | 5,134 | 7,722 | 1,090 | 2,110 | 190 | 370 | 10 | 30 |
| Greene | 22,883 | 9,051 | 13,832 | 2,300 | 3,500 | 500 | 600 | 50 | 60 |
| Grundy | 18,580 | 7,611 | 10,969 | 2,020 | 3,850 | 360 | 690 | 10 | 60 |
| Hamilton | 15,920 | 1,927 | 13,993 | 760 | 2,160 | 90 | 260 | 10 | 30 |
| Hancock | 28,523 | 8,266 | 20,257 | 3,160 | 5,810 | 460 | 850 | 10 | 60 |
| Hardin | 7,533 | 2,577 | 4,956 | 170 | 1,440 | 90 | 760 | 10 | 10 |
| Henderson | 9,770 | 0 | 9,770 | 850 | 1,700 | 130 | 260 | 10 | 10 |
| Hendry | 45,162 | 25,670 | 19,492 | 5,430 | 9,390 | 940 | 1,620 | 40 | 200 |
| Iroquois | 34,841 | 8,215 | 26,626 | 2,930 | 5,900 | 460 | 930 | 10 | 60 |
| Jackson | 37,091 | 16,970 | 20,121 | 3,700 | 6,630 | 650 | 1,170 | 10 | 50 |
| Jasper | 16,064 | 2,083 | 13,981 | 760 | 2,250 | 80 | 240 | 10 | 50 |
| Jefferson | 28,480 | 9,815 | 18,665 | 2,360 | 4,830 | 370 | 760 | 10 | 50 |
| Jersey | 12,682 | 3,839 | 8,843 | 940 | 2,080 | 130 | 290 | 10 | 30 |
| Jo Daviess | 21,917 | 8,607 | 13,310 | 2,360 | 4,250 | 380 | 690 | 20 | 80 |
| Johnson | 12,022 | 0 | 12,022 | 480 | 1,560 | 50 | 160 | 10 | 50 |
| Kane | 99,499 | 82,524 | 16,975 | 14,950 | 22,080 | 2,880 | 4,260 | 230 | 600 |
| Kankakee | 44,940 | 23,348 | 21,592 | 4,500 | 7,710 | 870 | 1,490 | 40 | 170 |
| Kendall | 10,074 | 1,473 | 8,601 | 840 | 1,770 | 120 | 250 | 10 | 10 |
| Knox | 46,727 | 28,263 | 18,464 | 6,730 | 10,500 | 1,120 | 1,750 | 110 | 260 |
| La Salle | 92,925 | 63,663 | 29,262 | 10,620 | 24,000 | 2,780 | 5,800 | 630 | 4001 |
| Lake | 74,285 | 44,040 | 30,245 | 7,770 | 12,340 | 1,720 | 2,730 | 180 | 860 |
| Lawrence | 21,380 | 9,502 | 11,878 | 1,790 | 3,500 | 360 | 400 | 50 | 80 |
| Lee | 28,004 | 10,135 | 17,869 | 3,010 | 5,260 | 680 | 790 | 30 | 40 |
| Livingston | 39,070 | 13,607 | 25,463 | 3,360 | 6,620 | 380 | 750 | 30 | 130 |
| Logan | 29,562 | 14,565 | 14,997 | 3,150 | 5,370 | 410 | 700 | 30 | 120 |
| McDonough | 27,074 | 11,819 | 15,255 | 2,930 | 5,240 | 330 | 590 | 20 | 90 |
| McHenry | 33,164 | 13,970 | 19,194 | 3,800 | 6,380 | 470 | 790 | 20 | 80 |
| McLean | 70,107 | 38,160 | 31,947 | 8,820 | 14,370 | 1,510 | 2,330 | 140 | 280 |
| Macon | 65,175 | 45,011 | 20,164 | 9,310 | 14,170 | 1,670 | 2,540 | 120 | 290 |
| Macoupin | 57,274 | 29,190 | 28,084 | 6,440 | 10,810 | 1,160 | 1,950 | 20 | 100 |
| Madison | 306,895 | 80,824 | 26,071 | 14,820 | 22,150 | 2,840 | 4,240 | 90 | 170 |
| Marion | 37,497 | 19,560 | 17,937 | 3,990 | 7,240 | 670 | 1,220 | 70 | 350 |
| Marshall | 14,760 | 6,807 | 7,953 | 1,600 | 2,780 | 280 | 490 | 10 | 40 |
| Mason | 16,634 | 5,494 | 11,140 | 2,030 | 3,200 | 550 | 700 | 130 | 170 |
| Massac | 13,559 | 5,055 | 8,504 | 1,160 | 2,390 | 170 | 350 | 10 | 50 |
| Menard | 11,694 | 3,673 | 8,021 | 1,160 | 2,150 | 180 | 330 | 10 | 30 |
| Mercer | 18,800 | 3,379 | 15,421 | 1,870 | 3,560 | 280 | 530 | 10 | 40 |
| Monroe | 12,839 | 3,522 | 9,317 | 840 | 1,940 | 120 | 280 | 10 | 40 |
| Montgomery | 41,403 | 19,923 | 21,480 | 4,970 | 8,170 | 880 | 1,450 | 20 | 90 |
| Morgan | 33,567 | 17,223 | 16,344 | 3,890 | 6,450 | 700 | 1,160 | 90 | 170 |
| Moultrie | 14,839 | 4,011 | 10,828 | 1,250 | 2,510 | 200 | 400 | 10 | 30 |
| Ogle | 26,830 | 8,654 | 18,176 | 2,790 | 5,180 | 420 | 780 | 10 | 50 |
| Peoria | 111,710 | 87,900 | 23,810 | 17,000 | 27,000 | 3,600 | 5,000 | 900 | 1,000 |
| Perry | 22,901 | 12,534 | 10,367 | 2,280 | 3,960 | 390 | 680 | 10 | 40 |
| Piatt | 15,714 | 4,946 | 10,768 | 1,640 | 2,970 | 260 | 470 | 10 | 30 |
| Pike | 26,866 | 4,962 | 21,904 | 2,050 | 4,580 | 280 | 630 | 10 | 50 |
| Pope | 9,625 | 1,242 | 8,383 | 410 | 1,290 | 40 | 130 | 10 | 30 |
| Pulaski | 14,629 | 5,417 | 9,212 | 1,420 | 2,590 | 240 | 440 | 10 | 30 |
| Putnam | 7,579 | 2,727 | 4,852 | 820 | 1,370 | 160 | 270 | 10 | 10 |
| Randolph | 29,109 | 11,209 | 17,900 | 2,330 | 4,630 | 390 | 780 | 20 | 80 |
| Richland | 14,044 | 4,491 | 9,553 | 1,230 | 2,520 | 180 | 370 | 10 | 50 |
| Rock Island | 92,297 | 77,127 | 15,170 | 14,740 | 21,040 | 2,780 | 3,980 | 230 | 380 |
| St. Clair | 136,520 | 110,849 | 25,671 | 20,260 | 30,330 | 3,800 | 5,680 | 210 | 800 |
| Saline | 38,353 | 16,212 | 22,141 | 3,840 | 6,770 | 690 | 1,220 | 10 | 50 |
| Sangamon | 100,262 | 69,673 | 30,589 | 13,020 | 20,810 | 2,400 | 3,840 | 310 | 550 |
| Schuyler | 13,285 | 2,275 | 11,010 | 900 | 2,130 | 120 | 280 | 10 | 10 |
| Scott | 9,489 | 2,549 | 6,940 | 820 | 1,660 | 120 | 240 | 10 | 30 |
| Shelby | 29,601 | 6,159 | 23,442 | 2,370 | 5,050 | 340 | 730 | 10 | 50 |
| Stark | 9,693 | 2,611 | 7,082 | 850 | 1,780 | 280 | 400 | 50 | 100 |
| Stephenson | 37,743 | 20,818 | 16,925 | 4,850 | 8,040 | 780 | 1,290 | 120 | 270 |
| Tazewell | 38,540 | 18,313 | 20,227 | 4,500 | 7,500 | 750 | 1,270 | 200 | 280 |
| Union | 20,249 | 4,109 | 16,140 | 1,280 | 2,830 | 210 | 460 | 10 | 50 |
| Vermilion | 86,162 | 48,117 | 38,045 | 10,750 | 17,440 | 1,890 | 3,070 | 110 | 370 |
| Wabash | 14,034 | 7,456 | 6,578 | 1,590 | 2,720 | 270 | 460 | 10 | 40 |
| Warren | 21,488 | 8,116 | 13,372 | 2,100 | 2,500 | 350 | 400 | 110 | 130 |
| Washington | 18,035 | 2,209 | 15,826 | 1,100 | 2,660 | 150 | 360 | 10 | 40 |
| Wayne | 22,772 | 2,754 | 20,018 | 1,030 | 3,070 | 110 | 330 | 10 | 40 |
| White | 20,081 | 3,967 | 16,114 | 1,410 | 3,200 | 200 | 460 | 10 | 50 |
| Whiteside | 36,174 | 17,713 | 18,461 | 4,200 | 7,180 | 690 | 1,180 | 20 | 90 |
| Will | 92,911 | 48,853 | 44,058 | 9,550 | 16,410 | 1,780 | 3,060 | 100 | 500 |
| Williamson | 61,092 | 33,333 | 27,759 | 6,430 | 11,270 | 1,170 | 2,050 | 20 | 80 |
| Winnebago | 90,929 | 68,175 | 22,754 | 14,230 | 17,200 | 2,860 | 3,170 | 710 | 700 |
| Woodford | 19,340 | 6,674 | 12,666 | 1,860 | 3,400 | 310 | 570 | 40 | 60 |

* Cities and towns of over 1,000 population.

# Explosion Pots Reduce Switch Trouble

## Bernard Price Believes Breaker Improvement Lies in Development of This Principle —Increases Velocity of Contact Separation, Protects Tank from Extreme Pressures, Minimizes Explosions

EXCELLENT results have been obtained in reducing oil-switch explosions and increasing rupturing capacity by the incorporation of explosion chambers in the circuit breakers on the Rand Electric Power Companies' systems, declared Bernard Price recently before a meeting of the South African Institute of Electrical Engineers. Prior to their use more trouble was experienced by this company with gaseous explosions and oil fires resulting from switch failure than by any other company of which he had knowledge, Mr. Price added.

"As the size of the system increased it soon became apparent that the switches were incapable of meeting the increasingly severe conditions obtaining on the occurrence of a fault.

"Reactors were installed in series with all the large generators on the system, and the neutral of each separate distribution network was earthed through a non-inductive resistance. Experience showed, however, that no reasonable increase in the inherent reactance of the system would sufficiently limit the rush of energy flowing to a fault between phases to bring it within the rupturing capacity of the switches as originally designed.

### Gases Must Have Free Path

"In this type of switch a free path exists for the gases produced by the arc to pass upward through the oil until they reach the air within the cover above the tank. Unless the arc is finally quenched before the gases reach the surface of the oil, or unless the gases themselves are sufficiently cooled in transit through the oil, a gaseous explosion may occur inside the switch, which bursts open the tank, expels a portion of the oil, and in some instances ignites the oil inside or outside the switch, thus producing an oil fire. Less frequently the gaseous explosion does not occur inside the switch, but the gases generated at the arc displace the air within the switch cover and eventually explode with the outside air on leaving the vent pipe which passes through the cover of the switch. It is probable that these external explosions occur only when the arc inside the switch is maintained for a period after the moving member has reached the end of its travel so that the gases have time to displace the air above the oil until finally a jet of flame or an incandescent particle escapes through the vent pipe and ignites the gaseous mixture outside the switch, or the gases themselves reach the air at a sufficiently high temperature to produce ignition.

"The first switches to give trouble were the triple-unit, single-pole switches controlling the 40,000-volt arteries of the system. Later the single-unit, three-pole, 20,000-volt feeder switches at substations in overhead sections of the system and the triple-unit, single-pole, 10,000-volt feeder switches at one of the generating stations gave similar trouble.

"When deciding how best to solve the problem we realized that the first essential was to eliminate the possibility of the gaseous explosion. Any ordinary damage to the replaceable contacts of the switch was of no concern provided the switch performed its duty of breaking the circuit without causing extensive damage to itself and neighboring apparatus. The means adopted for achieving this object were to inclose the arc in a relatively small insulated chamber (known as an explosion pot) attached to the insulator which carries the fixed contact inside the switch and arranged so that the gases generated therein by the arc were forced to follow the moving contact through an aperture in the lower end of the chamber and then bubble up through the mass of cold oil in the tank. This arrangement was not novel, and in adopting it we did not count upon any large increase of quenching power of the oil at the arc. Our primary object was to interpose a physical barrier in the path of incandescent particles between the arc and the air above the oil and to insure that the gas be too cool to ignite by the time it reached the air.

### Pots Eliminate Danger of Explosions

"The installation of these explosion pots in the 40,000-volt switches proved completely effective, there having been no subsequent instance of a gaseous explosion. When it became necessary to tackle the 20,000-volt substation switches we feared there might not be room in the three-pole single-tank units to accommodate six explosion pots of adequate size. Special tests were therefore carried out, and we took the opportunity to experiment also with certain alternative arrangements. We soon found that explosion pots of adequate size could be satisfactorily accommodated in the existing switches, but, of course, in this case, as in the previous case of the 40,000-volt switches, the length of break and depth of tank had to be increased considerably to insure that the moving contact would move well clear of the aperture in the pot at the end of its travel. Without waiting for further investigation about twenty feeder switches in substations were equipped with six explosion pots per switch, and no further trouble has occurred with these altered switches.

"In the case of the 10,000-volt, triple-unit, single-pole switches we first tried the effect of merely increasing the length of break of the existing switches, but this, though an improvement, was inadequate. Explosion pots were therefore inserted in about twelve switches.

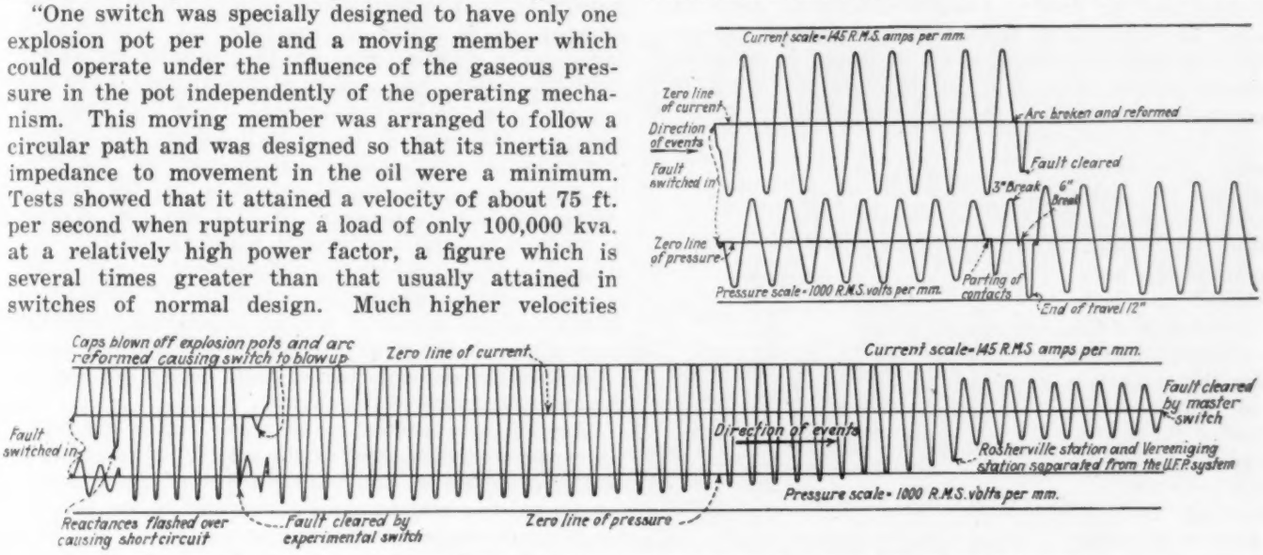
"The investigations carried out by the aid of the oscillograph when testing switches of various types on heavy faults with the whole system behind them brought out clearly the merits of the explosion-pot principle. We were not able to impose sufficiently severe conditions to reach (probably not even to approach) the limiting capacity of such switches, because, although we went so far as to switch a very heavy load onto the system as a whole, we did not feel justified in applying a dead short circuit to plant which was in commercial service.

"As anticipated, the gaseous pressure generated by the arc in the pot, acting on the moving member of the switch, accelerated the speed of the moving contact and of the operating mechanism to which the moving member

is connected. It became clear, moreover, that all excepting relatively small loads were interrupted during the very short interval of time taken by the arcing contact to traverse the length of the aperture of the pot. At the highest loads applied during the experiments we were unable to observe from the oscillograms any continuance of the arc after the contact had left the aperture. The point in the travel of the contact at which rupture of the circuit took place appeared to be fixed within the length of the aperture of the pot, and consequently the time of existence of the arc tended to become shorter as the severity of the fault increased and the velocity of the arcing contact became greater.

"One switch was specially designed to have only one explosion pot per pole and a moving member which could operate under the influence of the gaseous pressure in the pot independently of the operating mechanism. This moving member was arranged to follow a circular path and was designed so that its inertia and impedance to movement in the oil were a minimum. Tests showed that it attained a velocity of about 75 ft. per second when rupturing a load of only 100,000 kva. at a relatively high power factor, a figure which is several times greater than that usually attained in switches of normal design. Much higher velocities which was set to operate with a time lag of one second. This master switch was one of our 40,000-volt switches fitted with explosion pots and operated at 20,000 volts.

"On examining the experimental switch it was found that the fiber insulating caps which formed the lower ends of the explosion pots had been blown out on two of the three phases owing to defective screw threads on the steel locking rings which hold these caps in place. Abrasions on the fiber corresponding with the configuration of the moving contact prove conclusively that these caps had been blown on to the moving contact after the latter had cleared the aperture in the cap, and this evidence combined with the oscillogram leaves no doubt


Current scale = 145 R.M.S. amps per mm.
Zero line of current
Direction of events
Fault switched in
Arc broken and reformed
Fault cleared
3" Break
6" Break
Zero line of pressure
Pressure scale = 1000 R.M.S. volts per mm.
Parting of contacts
End of travel 12"
Caps blown off explosion pots and arc reformed causing switch to blow up
Zero line of current
Current scale = 145 R.M.S. amps per mm.
Fault cleared by master switch
Fault switched in
Direction of events
Rosherville station and Vereeniging station separated from the U.F.P. system
Pressure scale = 1000 R.M.S. volts per mm.
Reactances flashed over causing short circuit
Fault cleared by experimental switch
Zero line of pressure

PERFORMANCE OF EXPERIMENTAL CIRCUIT BREAKER HAVING SLIDING-SLEEVE MECHANISM

would, of course, be reached under the conditions of a short circuit, but we were unable to measure these.

"By a fortunate accident, however, we were able to prove that the rupturing capacity was ample for meeting short-circuit conditions on our system. Choking coils without additional resistances had been inserted in the circuit of a size calculated to produce a load approximately equal to the 100,000 kva. above mentioned, but with a power factor of only about 10 per cent lagging. Immediately on closing the experimental switch these reactances flashed over and caused a short circuit which from the oscillogram is shown to have reached a practically steady value of about 8,700 amp. by the time when the switch contacts began to part. This very heavy load wiped out the voltage, and consequently no detailed records of the times and speeds of opening were obtained, but the oscillogram shows that the time taken for the switch to rupture the fault current was about the same as when breaking the 100,000 kva. in the previous test, namely, rather less than one complete cycle from the moment when the contacts began to part.

"About half a cycle after the circuit had been ruptured the switch blew up, and this reimposed a short circuit on the system. The oscillogram clearly shows this restarting of the load and the manner in which it gradually diminished until at the forty-third cycle the operation of sectionalizing switches at generating stations subdivided the system and reduced the capacity of plant feeding the fault. At the fifty-second cycle the fault was cleared by the master switch, which had been connected in series with the experimental switch and that the switch had ruptured the circuit quite satisfactorily and that no subsequent damage would have occurred if the caps of the explosion pots had been properly held in place.

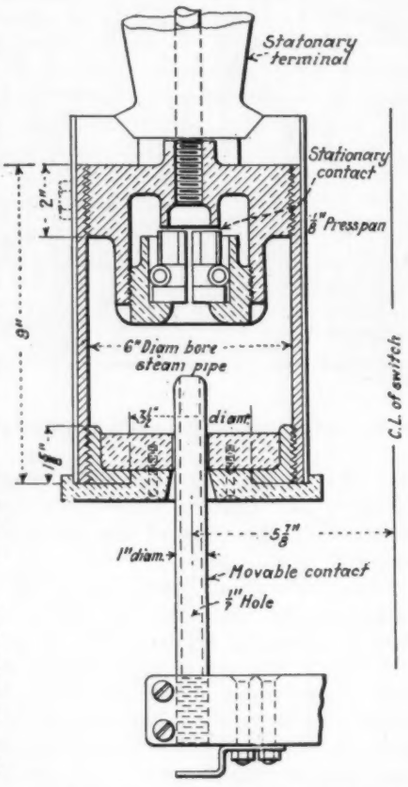
"The conclusion drawn from all these tests with explosion pots was that the rupturing capacity at the moment when the arcing contact is passing through the aperture of the pot is exceptionally high (we failed in fact to determine where the limit is reached), and I think a little consideration will show that this is only to be expected. From the moment when the contacts part from one another gas is generated at a more or less uniform rate along the length of the arc. This means that after a given interval of time, counted from the moment when the contacts first separate, the quantity of gas which has been generated at any particular point along the path of the arc will be a function of the period during which the arc has existed at that particular point. Assuming, for example, that the arcing contact has almost reached the inner entrance of the aperture, so that the arc is passing from the fixed contact to a point near the lower end of the pot, then the quantity of gas generated at the upper end of the arc will be greater than that at the lower end.

"During the movement of the arcing contact the volume of that portion of the moving member which has passed out of the pot will have been replaced by an equal volume of gas generated under high pressure in the pot, and inasmuch as the major portion of this gas has been generated in the upper regions of the pot the tendency will be for the oil to be forced radially outward from the upper portion of the arc and radially inward to

fill the space vacated by the moving contact at the lower end of the arc.

"Now imagine what happens when the moving contact continues its travel and passes through the aperture in the lower end of the pot. This aperture may be of any desired length. In the pots used during the experiments it consisted of a circular hole through the thickness of the end disk of the pot. This disk had to be made of insulating material strong enough to withstand the high gaseous pressures created in the pot and was about 1 in. in thickness.

"It will be clear from the above that the oil at the lower end of the pot will be forced to follow the arcing contact and in flowing inward radially to enter the aperture will be projected into the arc at high velocity. This velocity will depend upon the speed at which the arcing contact is moving. If injection of oil into the arc at this velocity fails to rupture the circuit, a further change occurs when the arcing contact leaves the aperture of the pot. Immediately the aperture is thus opened the velocity of the oil which is following the contact is no longer controlled by the speed at which the contact is moving, and the gaseous pressure inside the pot is at once relieved by a sudden rush of oil through the aperture, and therefore through the arc.




CROSS-SECTION OF EXPLOSION CHAMBER WITH WHICH EXPERIMENTS WERE CONDUCTED

"The explosion pot harnesses the energy dissipated by the arc and puts it to that beneficial use. Not only does it confine the damaging effects produced by the arc and thus relieve the whole structure of the switch from mechanical strain and prevent the arc from gaining access to the air, but it applies the energy in the arc to accelerate the speed with which the arc is lengthened and the velocity with which the quenching medium is introduced into the lengthening arc. A further most valuable feature of the principle in question is that the available energy increases with the severity of the task it is called upon to perform.

"Looking forward there would seem to be room for further development of the explosion-pot principle in the direction of increasing the velocity of both moving contact and oil. The velocity of the moving contact can be increased by enlarging the area on which the pressure operates, but this involves a corresponding increase in the area of the aperture through which the oil is expelled from the pot when the moving contact is withdrawn. So great is the pressure in the pot at this moment that its sudden release through a relatively large aperture can impose considerable mechanical strain on the inclosing structure of the switch.

"Maximum quenching power will occur when the velocities of the moving contact and oil are both a maximum, and this occurs when the moving contact has just left the aperture in the pot and the flow of oil, being no longer controlled by the velocity of the moving contact, is discharged under the influence of the full difference of pressures inside and outside the pot. In order to give the moving contact the highest possible velocity at this moment without imposing an undue strain on the outer structure of the switch, the aperture may be fitted with flap doors, a spherical plug or other suitable means for partially closing the aperture at the moment when the moving contact is leaving the pot. These doors operate under the influence of the oil as it follows the moving contact into the exit passage and automatically constrict the aperture to any desired extent before the moving contact has left the passage. In this way the arc may be confined to a passage through which the oil is forced at the full velocity which the difference of pressures can produce, which passage is automatically constricted from an initial size large enough to produce maximum acceleration of the moving contact to a final one small enough to prevent any undue strain being imposed on the outer structure of the switch.

"Another arrangement which would render the velocity of the oil independent of the velocity of the moving contact at an earlier point in the travel of the switch is one in which a vent passage is provided in the body of the moving member itself so arranged that its entrance is located at the center of the surface from which the arc strikes and its exit at a suitable point along the side of the moving member. During the earlier portion of the travel of the moving member the exit of this internal passage would be inside the aperture of the pot and would therefore be closed by the side of that aperture, but immediately the exit has passed outside the pot the oil would find a free exit through the passage and would be discharged at full velocity under the difference of pressures inside and outside the pot. The stream of oil entering the passage would have to flow across the arc at every point, and by placing the exit at a suitable position along the moving member the sudden discharge of oil could be made to take place at any desired point during the travel of the moving contact inside the pot. Unless the aperture of the pot is relatively small in area, however, it would still be necessary to provide means such as those already described for constricting that aperture when the moving contact is fully withdrawn, as unless this were done the surrounding structure would be subjected to mechanical strain.

"In my opinion, the high-tension switch of the future will embody the explosion-pot principle and may be developed along some such lines as those I have indicated. Development in the direction of bomb-proof switch tanks is, in my opinion, mistaken because it does not attack the problem at its source."

Mr. Price stated that he did not anticipate that the use of explosion pots would cause any undue retardation of the moving member when synchronizing, as the clearance between the sides of the moving member and the aperture of the pot was appreciable and there were two small vent holes at the top of the pot through which the gases generated at the arc were able to escape.

# Electric Furnaces Extensively Employed in Germany

## Seventy per Cent of Steel Works Use Them for High-Grade Steel—Induction Furnaces Finding Wide Application —Results Obtained from Several Installations Are Cited

By CAPT. GODFREY L. CARDEN

IN THE course of visits to iron and steel works in central Europe in the past three months I was impressed by the very general recourse to electric furnaces. Both induction and arc furnaces are in evidence, the Röchling-Rodenhauser induction furnace appearing to be the one most in favor. The arc furnaces in use are mostly of the Bonn or the Gesta types. The Bonn is an arc-radiating furnace while the Gesta is an arc-resistor furnace.

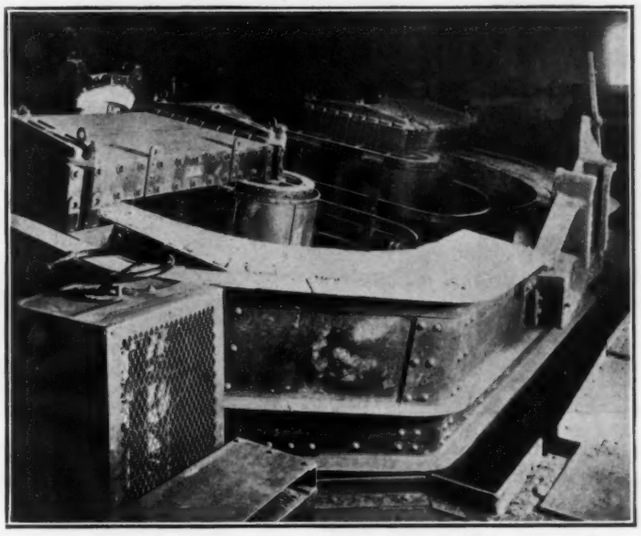
Dr. Engelhardt, the director of the electric-furnace construction department of Siemens & Halske Company, Siemens-Schuckert Works, and a recognized authority in Germany on electric furnace work, pointed out to me that fully 70 per cent of all the high-class steel-making firms of Germany today are employing electric furnaces, which are installed either singly or in groups. These furnaces are being used either independently or as complements to older-type furnaces. This recourse to electric furnaces, he said, is a development of the last few years and has come about through the success attending the first serious attempts to produce high-grade steel by the electric process.

Viewed from the economic standpoint, Dr. Engelhardt says, the electric furnace offers its greatest advantages in territory where cheap electric energy is obtainable from streams. In Germany these natural advantages are not present and in consequence the energy must be obtained mostly from coal. Notwithstanding the higher cost, the Germans have found the electric furnace too important an accessory to ignore, and especially so because of the superior services rendered in production problems of different kinds.

The electric furnace, it is found, can readily be adapted to varied applications in steel works and quickly adjusted to handling of charged as well as finished material. In Germany as a general rule one finds the electric furnace in use in the small crucible steel and metal works in lieu of a crucible or cupola furnace. Machine shops and shipyards, too, have got into the habit of using electric furnaces for smelting on jobs where steel or cast-iron parts are wanted urgently.

Among the larger German high-grade steel works the electric furnace supplements the Martin furnace or converter. Here, it is observed, the charge can be decarbonized and dephosphorized and then carried over in liquid form for a further treatment in the electric furnace. The steel that results from this treatment is more satisfactory, it is declared, than the usual form of Martin or Thomas steel.

The German iron industry is using very generally the electric furnace for remelting ferric alloys, metal and metal alloy. A decided advantage results from this practice when comparison is made with similar



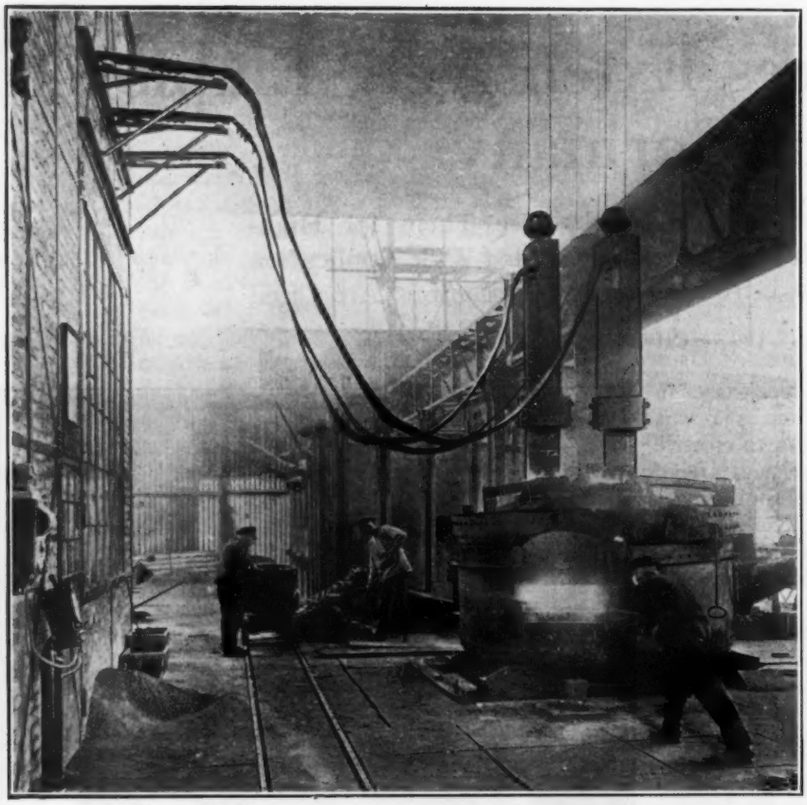
ONE OF THE SIX 8-TON RÖCHLING-RODENHAUSER INDUCTION FURNACES PRODUCING HIGH-ALLOY STEEL AT THE BECKER STEEL WORKS, KREFELD

work produced by cupola or hearth furnaces. Recourse to the electric furnace assures elimination of practically all influx of external impurities and prevents diminution in the metal consumption. Distinct advantages possessed by the electric furnace, in comparison with the older types, are: (a) Ability to obtain an extraordinarily rapid and intense heat; (b) ability to obtain higher temperature than can be reached in other furnaces; (c) easy adjustment of temperature by means of regulating the furnace voltage; (d) the electric current gives the purest heating by eliminating all impurities from fuel or combustible; (e) the process of refinement of the charge can be carried out to any desired extent and the highest-grade steel produced for machine-tool steel, high-alloy plate iron for dynamo engines and transformers and other forms of high-class construction work.

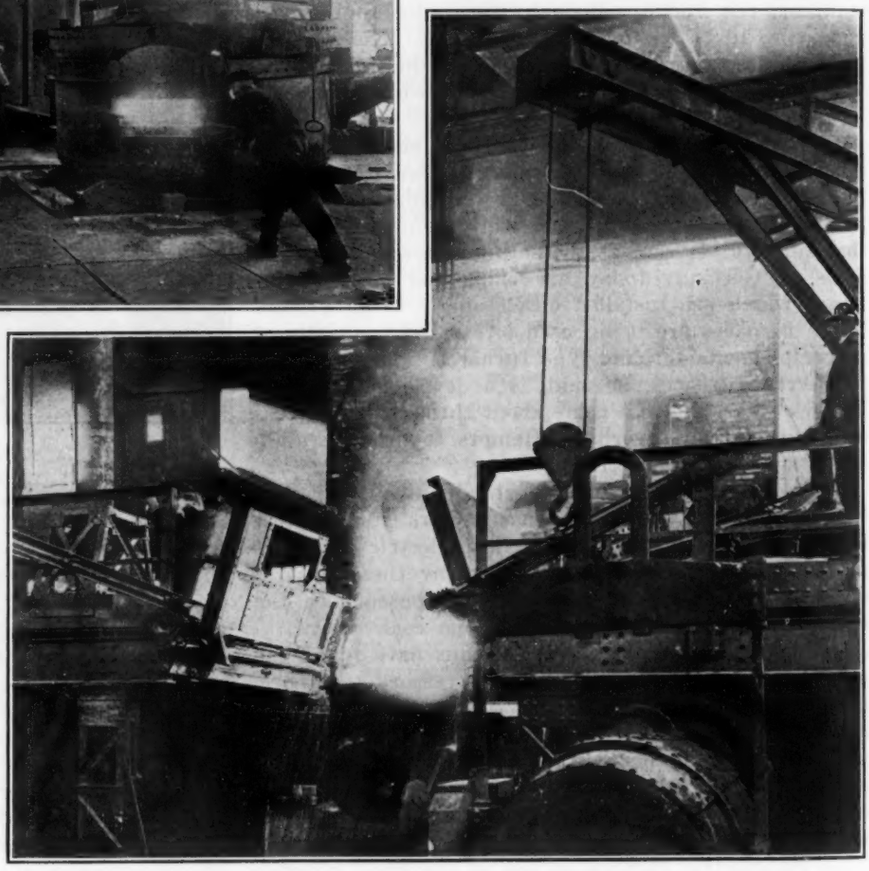
In the light of every-day practice, the German iron and steel works are employing the electric furnace for work as follows:

1. For the melting of scrap and other cold charges.
2. In oxidation process for the removal of such impurities from the molten charge as can be disposed of by oxidation.
3. For the deoxidation of a melted bath for removing sulphur after eliminating the oxide dissolved in the iron.
4. For carbonizing, alloying and finishing of steel.

As to the particular type of electric furnace to be used, this depends on the work to be performed, the



Company, Siemens-Schuckert Works, has succeeded through the use of electrode regulators in reducing the current surges ordinarily occurring during the working process. Recently these furnaces have been supplied with especially constructed graphite electrodes which permit operation at a very high current density. A high production per kilowatt-hour is obtained, and the consumption of electrodes has been greatly reduced. For example, in the steel-casting process the energy consumption per ton in a furnace of from 5,000 kg. to 6,000 kg. holding capacity is 650 kw.-hr., and in high-speed machine-tool steel production between



THREE 4-TON HEROULT FURNACES, TWO OF WHICH ARE SHOWN, MAKE STEEL FROM COLD IRON SCRAP IN THE SAXON STEEL CASTING WORKS, DÖHLEN

purity of the charge and the finished material, the assumption always being that the purpose is to produce high-grade steel.

Where an arc-system furnace is employed the type may be either direct or indirect arc heating. The smaller steel works are inclined to use the Bonn type of furnaces. This is a direct-arc-heating furnace standardized for three-phase current. Here the pressure varies from 105 volts to 135 volts according to the size of the furnace. By means of a stationary transformer this furnace can be connected to any three-phase circuit. It is the common practice to use this furnace for charges of 200 kg. to 3,000 kg.

The Bonn furnace is regarded as especially advantageous for treating scrap, shavings and similar material. A small electric motor is used for tipping the large tanks; when small tanks are used they are arranged for tipping by hand. The tank is lined with refractory bricks and compound having basic or acid quality according to the kind of steel to be produced.

### DIRECT-ARC FURNACES—LARGER TYPE

For charges of 20 tons or more the Germans seem to be favoring the Heroult direct-arc furnace. This type, which is probably better known in America than more recent furnaces, is employed in Germany for reducing cold iron or steel scrap into cast-steel form, or high-grade steel, and also for the treating of liquid charges. The furnace department of Siemens & Halske

800 kw.-hr. and 900 kw.-hr. The electrode consumption when using graphite electrodes amounts on the average to from 3.5 kg. to 4 kg. per ton of product.

Wide application of the induction furnace is now being made in German high-grade steel works. It is estimated that fully 70 per cent of the German works making high-grade steel are employing induction furnaces. The furnace which is being used has a hearth which is accessible through two doors—one for charging or admitting alloy and the other for removing slag. It is especially fitted for handling a liquid charge as a supplement to the preliminary work carried on in the Martin furnace or converter.

The Röchling-Rodenhauser furnace has been found especially advantageous because of its good over-all

thermal efficiency, ease and accuracy of temperature regulation, small unit energy consumption and very low electrode consumption. This last is important because of the present high cost of electrodes in Germany.

Because of its advantages the induction furnace has come into very general use for making high-grade dynamo steel, ferro-manganese, brass and bronze. The zinc losses are roughly 1 per cent with a charge of 1,000 kg. at a temperature of about 1,050 deg. C. The circulation of the liquid charge gives a nearly perfect mixing effect for steel, brass and bronze. In a number of the German high-grade steel works these induction furnaces run to ratings of 8 tons to 12 tons capacity. There are no losses from metal burning during the smelting process when using this furnace in smelting ferro-manganese. In this case the saving is about 30 per cent.

The Röchling-Rodenhauser furnace is built for experimental work for charges of from 200 kg. to 500 kg., and for ordinary work for charges ranging from 2 tons up to 20 tons. For smelting copper alloys the furnaces employed have capacities ranging from 200 kg. to about 6 tons.

### Typical Installations in German Factories Using Large Induction Furnaces

Noteworthy among the German works using induction furnaces are the following:

Stahlwerk Becker A.G. at Willich near Krefeld.—Six 8-ton induction furnaces especially adapted for production of high-alloy plate iron.

Edelstahlwerk Röchling A.G. at Völklingen on the Saar.—One furnace of 10 tons, one of 8 tons and three of 7 tons. These furnaces are designed for making high-grade steel from liquid charge obtained from Thomas and Martin steel furnaces.

Stahlwerke Burderus-Röchling A.G. at Waltzlar.—Two furnaces of 8 tons and one furnace of 4 tons, all used for making high-grade steel from liquid Martin steel.

Werk Dommeldingen der Vereinigten Hüttenwerke Burbach-Eich-Düdelingen A.G. at Dommeldingen.—Three furnaces of 3.5 tons capacity for making high-grade steel from liquid Martin steel, and two furnaces of 1.5 tons and one of 0.7 ton for bronze work.

Krefelder Stahlwerk A.G. at Krefeld.—Two furnaces of 8 tons for making high-grade steel from liquid Martin steel.

Berglische Stahlindustrie, G.m.b.H., at Remscheid, Rhineland.—Two furnaces of 5 tons capacity each for working high-grade steel from liquid Martin steel.

### Arc Furnaces Used in German Foundries

Of late the German cast-iron plants have taken up the use of electric furnaces, utilizing them for enriching the liquid cast iron as it comes from the cupola furnaces. In smelting aluminum, for example, and in working zinc both induction and arc furnaces are employed. Arc furnaces are more generally used where the problem calls for the smelting of a succession of different kinds of metal. The induction furnaces are deemed better to employ where longer periods are required, as, for example, in smelting bronze and aluminum. Dr. Engelhardt is of the opinion that the induction furnace is yielding the best and purest results, viewed as a smelting apparatus. He bases this statement on the extremely insignificant metal loss, which, he declared, is only 0.5 per cent.

There is no question, from what I observed, that the induction furnace has come to stay among the German plants and that its use accounts for much of the success which the Germans are achieving in the production of high-grade metals.

## Letters from Our Readers

**A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute**

### Field Test for Insulators

*To the Editors of the* ELECTRICAL WORLD:

Under the heading "Practical Field Testing of High-Tension Insulators" in the July 14 issue of the ELECTRICAL WORLD mention is made of a method of testing transmission line insulators by the use of a vacuum tube detector.

More than a year ago C. J. Barrow talked with me in reference to some method of testing transmission line insulators which would show on an instrument scale the electrical condition of a transmission line insulator. After some study I suggested the use of a vacuum tube detector for this purpose and sketched out and described several apparently possible ways of using this scheme.

Development of the idea was delayed by other work, but recently considerable experimenting has been done along this line with promising results. E.P.PECK,

General Superintendent Electrical Department.
Utica Gas & Electric Company,
Utica, N. Y.

[Credit is due Mr. Peck for the idea incorporated in the editorial mentioned.—EDS.]

### Applauds Professor Karapetoff's Message

*To the Editors of the* ELECTRICAL WORLD:

Just as a plain lay reader, I was interested in Professor Karapetoff's letter in the ELECTRICAL WORLD of July 7, published under the title "Working for Unborn Generations." It seems to me that the writer represents the true scientific spirit and has given us a helpful message, for which he is entitled to thanks. Let us all try to be sane, well-balanced human beings in our work and in our play, trying always to give fellow mortals a lift, trying not to take ourselves too seriously, on the one hand, or over-modestly on the other.

Chicago, Ill. CHICAGOAN.

### Part Which A. E. S. C. Plays in Standardization

*To the Editors of the* ELECTRICAL WORLD:

In several recent meetings at which the question of standards in the electrical industry has been discussed it has been brought out that there is frequently a misunderstanding on the part of people and of organizations as to the particular part which the American Engineering Standards Committee plays in standardization. I think it should be emphasized, and repeatedly, that the American Engineering Standards Committee is not itself a standardizing body; that the sectional committees are committees of the sponsor bodies, responsible to the sponsor bodies for their reports and findings, and that the American Engineering Standards Committee can take no action until the sponsor body, through its committee, is ready to submit its findings for American standardization.

Organizations not fully acquainted with the A. E. S. C. should not look upon it as a super body to produce standards; it does not take away the rights and prerogatives of other organizations in this regard.

C. E. SKINNER,
Assistant Director of Engineering.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

# Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

## Periodic Meter-Testing Methods

### Sectional Map of City Found Useful in Routine Testing of Residence Meters—Unit Testing Costs Are Given and Record Cards Shown

TESTING of fifty thousand residence meters once every three years in compliance with the requirements of the utilities commission is a task that requires careful and systematic planning to keep testing cost to a minimum. To do this the Portland (Ore.) Railway, Light & Power Company keeps a crew of eight testers in the field continuously. The residential section of Portland is divided into sections eight blocks square and to each section a number is given. Testers are assigned to various sections and complete all tests in one section before beginning on the next. When a section has been completed, the date and the name of the tester are written in the section on the map and shaded in red. By this means the progress of testing is noted at a glance. The same order is followed every three years, so that the meters are tested at equal intervals. The tester goes to each house where service enters and thereby becomes responsible for testing every meter in that section. Formerly the method of writing out a test card from the meter location records and giving the test cards to the tester to follow up was used to cover the entire district. It was found that this method was too cumbersome and that by following the section method twice as many meters could be tested.

The rules of the Public Service Commission require that residence meters be tested every three years, small power meters yearly and large power meters every six months. In addition every meter must be tested within thirty days after installation. On account of the installation test no shop tests are made on new meters or old meters removed, except where a meter seems to be defective or a complaint has been made. Testing requirements on meter accuracy are from 96 to 104 per cent, although meters are to be left calibrated within 1 per cent according to the rules. With these limits a record of meter tests is kept showing various types of meters found running between 96 and 104 per cent, under 96 per cent and over 104 per cent. Tests during 1921 showed 91 per cent of all meters operating between 96 and 104 per cent, 7 per cent below 96 per cent and 2 per cent above 104 per cent of accuracy. In other words, only 2 per cent of all meters were operating in a way detrimental to the customer.

From sixteen to twenty residence meters are tested daily on routine tests, and from twelve to sixteen on installation tests. In addition, from eight to twelve small power meters and six to eight large power meters are tested each day. Average testing costs per meter are: Residence meters, 38 cents; small power meters, 58 cents, and large power meters, 80 cents to $1.40, depending upon whether a helper is required. A crew of eight testers is required for residence meters, two for small power meters and one tester and helper for large power meters.

The standards used consist of a primary standard, Leeds & Northrup potentiometer, secondary standard, Westinghouse, General Electric and Weston wattmeters, voltmeters and ammeters, laboratory rotating standards, Westinghouse rotating watt-hour meter, portable rotating standards, Westinghouse, General Electric and Mowbray watt-hour meters. The secondary standards are tested every three months, the laboratory rotating standard once a month and the portable standards once a week. The standards used in the field for testing residence meters are equipped with lamp banks for loading. A phantom load box is used for power meters having an inductive load and a carbon rheostat for direct-current meters. Large-capacity direct-current meters on continuous service are tested on a series of running loads.

The records consist of a meter card (shown herewith) filed numerically according to the meter numbers, a

FORM 7
METER NO. 51601 SUFFIX 3½ I-14 SYMBOL C

| MAKE | AMP. | VOLTS | DIAL CON. | CAL CON. | WIRE | TYPE | MISC. |
|---|---|---|---|---|---|---|---|
| GE Co | 5 | 110 | 1 | .3 | 2 | I-14 | FACTORY NO. 2378654 |

| ADDRESS | INSTALLED | REMOVED | READING |
|---|---|---|---|
| 423 East 43 North | 6-3-22 | | |

FORM 8 THE IVY PRESS 38023

METER TEST CARD

No. 36513 K. 1 Type I Cal. K. 1.75 Date 6-3-19

Name A. B. Johnson Location

| AS FOUND TEST | | | | AS LEFT TEST | | | |
|---|---|---|---|---|---|---|---|
| Revolutions | | % | Load | Revolutions | | % | Load |
| Standard | Meter | | | Standard | Meter | | |
| 12.5 2 | 2 | 99.9 | 1 amp. | 17.5 2 | 2 | 99.9 | 1 amp. |
| 12.5 2 | 20 | 100. | 10 " | 17.5 2 | 20 | 100. | 10 amp. |

Ground Test O.K. Register Ratio 66⅔

Reading 0555 Time of Test 1:20 to 1:30 Total Time 10 Seal No. 41

Remarks

Signed B. P. Glendenning

AT LEFT—SAMPLE METER CARD FROM CONSECUTIVE CARD FILE. AT RIGHT—TYPE OF CARD FOR RECORDING TEST DATA

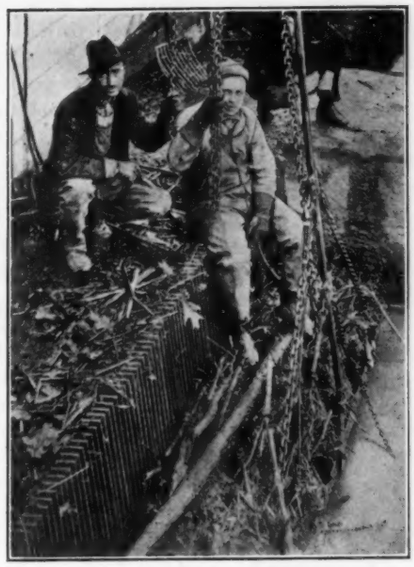
location card filed according to address, and a test card (also shown) for records of tests. It is thus possible to locate a meter either by number or address. A separate location card file is also kept for all meters which are required to be tested at six-month or yearly intervals so that periodic tests of these meters may be made. Changes in location, etc., are posted on these active files from service orders on which "connects" or "disconnects" are executed.

A. H. KRUEL,
Assistant Superintendent
Meter and Service Department.
Portland Railway, Light & Power Company,
Portland, Ore.

## Power Rake Handles Trash in Large Quantities

FEW hydro-electric plants have to contend with as much trash in the forebay as the Morgan Falls station of the Georgia Railway & Power Company on the Chattahoochee River. Trash not only floats on the surface but comes down the river in various stages of submergence so that booms are of little avail except in diverting the upper layer. Furthermore, the trash is not alone small débris but even includes waterlogged stumps, trunks, branches, scows, etc., washed into the river from the extensive watershed by the spring torrents.

After about twenty years' experience handling such trash by various methods, W. C. Sullivan, foreman of the Morgan Falls station, devised an electric hoist rake which he made out of surplus material around the plant, the electric hoist being about the only part requiring an investment. According to Fred W. Hadley, superintendent of water power of the company: "The power rake has given by far the best satisfaction in handling material of the kind with rapidity of anything that I have yet known about. The best thing about it is that it is heavy and rugged and does not get out of order."

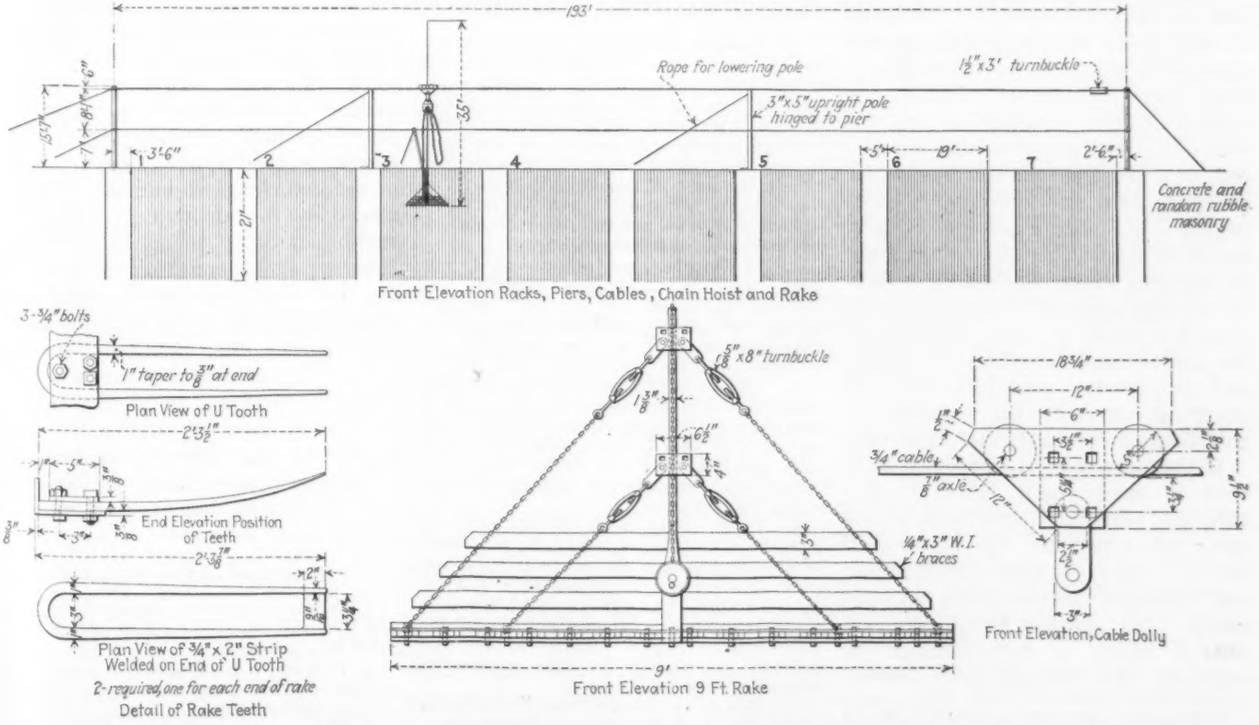


ELECTRIC HOIST RAKE THAT EFFECTIVELY CLEANS TRASH FROM FOREBAY

The construction of the outfit and method of using it are well shown by the accompanying illustrations. In general, it consists of a structural-steel rake with tool-steel teeth and a 1⅜-in. steel handle which slides through a short section of pipe attached to the motor-driven chain-hoist carriage. The hoist carriage runs on a plow-steel cable stretched between supports so that it runs over the top of the forebay racks. About 24 ft. upstream from the racks and just above the water level is stretched a ½-in. guy wire carrying a dolly to which a ½-in. block and tackle is fastened for pulling the rake away from the racks while lowering it to take a load.

The rake proper consists of a 9-ft. "L" measuring $\frac{7}{16}$ in. x 3 in. x 6 in., to which are fastened U-shaped teeth about 27 in. long and slightly more than 3 in. between centers. Between the tips of two teeth at each end of the rake are welded strips which prevent the teeth projecting through the rack. The method of fastening the teeth to the cross-bar of the rake is shown.

The handle of the rake, which consists of a 1⅜-in. tool steel 35 ft. long, is flattened at its lower end and bolted to a piece of strap iron, which in turn is bolted to the rake cross-member. A ring is also fastened to this strap for attaching the chain from the motor-driven hoist and the block and tackle for pulling the rake away from the racks in lowering.


193'
Rope for lowering pole
1½"x3' turnbuckle
3"x5" upright pole hinged to pier
35'
3'-6"
19'
Concrete and random rubble masonry
Front Elevation Racks, Piers, Cables, Chain Hoist and Rake
3-¾" bolts
1" taper to ⅜" at end
Plan View of U Tooth
End Elevation Position of Teeth
Plan View of ¾" x 2" Strip Welded on End of U Tooth
2- required, one for each end of rake
Detail of Rake Teeth
⅝" x 8" turnbuckle
¾" cable
⅞" axle
¼"x3" W.I. braces
Front Elevation, Cable Dolly
9'
Front Elevation 9 Ft. Rake

GATE RACKS AND RAKE AT MORGAN FALLS DEVELOPMENT OF THE GEORGIA RAILWAY & POWER COMPANY

Chains containing turnbuckles at the upper ends tie the outer ends of the rake and intermediate points to the tool-steel handle. In the latest model of the rake ¾-in. x 3-in. strap-iron pieces are fastened to the chains parallel to the rake cross-member to prevent the load on the rake falling out between the chains. Other details, such as the method of preventing the span wire sagging too much, are shown in the illustrations.

The 1-ton electric chain hoist, which does not show in the illustration, is of the hook type and is equipped with a 35-ft. lift chain and a special cover to keep off the rain. No trouble has been experienced with it due to moisture or exposure.

At the station where this rake is used insufficient space is provided at the top of the racks for depositing the débris raked from the racks —at least 15 ft. or 20 ft. should be available. Hence in clearing away the trash which is raked onto the platform at the top of the racks it has to be loaded onto a flat boat with coke forks. The flat boat used is just long enough to rest against the piers on each side of a rack while being loaded. If a sufficiently wide platform is provided at the top of the racks, a sluiceway is not needed as the débris deposited there can be cleared away by cheap labor.

FIELD EDITOR ELECTRICAL WORLD.
New York City.

# Extracts from an Operating Code*

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

## Charging Control, Power and Excitation Batteries

IMMEDIATELY after discharge the deposit on the plates of storage batteries is soft and porous and can be readily penetrated by the electrolyte, if recharged at once. On standing discharged for some length of time the deposit becomes hard and impervious to the action of electrolyte on charging. This hardening of the deposit is known as sulphation.

In the charging of a battery a certain amount of current is expended in chemically changing the deposits upon the plates. Any amount of current above this passed through the battery causes electrolysis of the water in the electrolyte with the formation of oxygen gas bubbles at the positive plate and hydrogen at the negative. Similar gassing is produced by continuing the normal rate of charging current after the battery is fully charged. If gassing is excessive, it is likely to cause shedding of the active materials from the plates and to develop resistance to the charging current, on account of polarization, which causes heating.

If the service of a battery is such that it must stand idle for considerable periods of time, local action takes place between the plates and the electrolyte, causing loss of charge and eventual deterioration of the plates. To prevent this, a trickle charge which is just sufficient to maintain the voltage and specific gravity constant but not to replace any loss due to use is applied at all times, except when the normal charge is being given, or a floating charge which is sufficient both to prevent local action and to replace the loss of voltage and specific gravity due to use is applied continuously.

When a method of trickle charging or floating is provided maintain the specified charging rate at all times, except when the battery is being charged normally.

### Charging Control and Power Batteries

1. Charge these batteries as often as the daily readings of the pilot cell or the voltage and specific-gravity readings of the individual cells indicate that it should be done. The lower limit for voltage is 1.85 volts per cell in the case of control batteries and 1.9 volts per cell in the case of power batteries. The lower limit for specific gravity is 0.030 lower than the maximum reached on the previous equalizing charge.

2. If the charging equipment is not such that the charging current decreases automatically as the voltage across the battery increases, reduce the charging current as the battery approaches the fully charged condition.

3. The battery is fully charged, first, when all cells are gassing moderately and uniformly from both positive and negative plates; second, when the specific gravity is 0.003 lower than the maximum reached on the preceding equalizing charge.

4. Once every week, in the case of power batteries, and once every two weeks, in the case of control batteries, give the battery an equalizing charge by continuing the charge until there is no increase in the specific gravity of the pilot cell or in the voltage across the battery, as shown by five successive fifteen-minute readings.

5. Keep the room well ventilated while the battery is being charged.

6. Do not bring an unprotected flame into the battery room (blowtorch, lighted cigars, cigarettes or pipes, etc.).

### Charging Excitation Batteries

The conditions of use of these batteries vary at different stations. Where the conditions are similar to those of power batteries follow the rules of charging power batteries. Where conditions are similar to those of control batteries follow the rules for charging control batteries.

## Instructions for Starting Turbo-Generators

ASSURANCE that bearings are floated in oil and warming up a unit gradually are two of the outstanding requirements in starting turbo-generators, especially when they run into large sizes. Before the load is actually put on the turbine every precaution must be taken to reduce the amount of air in the condenser to a minimum and steam must be admitted gradually, not only to minimize strains in the turbine but also to prevent any pocketed water which may exist, causing damage to the blades. Any excessive vibration of the unit during starting should be considered as a precursor of trouble within the unit. To minimize the air in the condenser the relief valve on the top of the discharge end of the condenser should be open when the condenser is being filled with water so that air will not become trapped. This will also indicate by overflowing when the condenser is filled with water. In establishing a vacuum an air ejector will handle a considerable volume of air against a low vacuum, while the air pump will handle smaller quantities of air against high vacuum. Consequently the ejector is used up to 10 in. or 15 in. of vacuum, from which point it is replaced by the air pump. Until the turbine gets up to speed it is the function of the auxiliary oil pump to put pressure upon the bearings and governor until it is automatically replaced by the shaft-driven oil pump. When shutting down a machine the auxiliary pump also serves to put oil pressure on the bearings to prevent any possible damage.

Detailed instructions for inspecting the turbine before starting and for starting follow:

### Inspection Before Starting

1. When a gravity lubricating system is used, see that oil is being supplied to all bearings.

2. Remove all bolts, tools and other articles which may have been left on or near the machine.

3. Make a general inspection to see

*Abstracted from the operating code of the Philadelphia Electric Company.

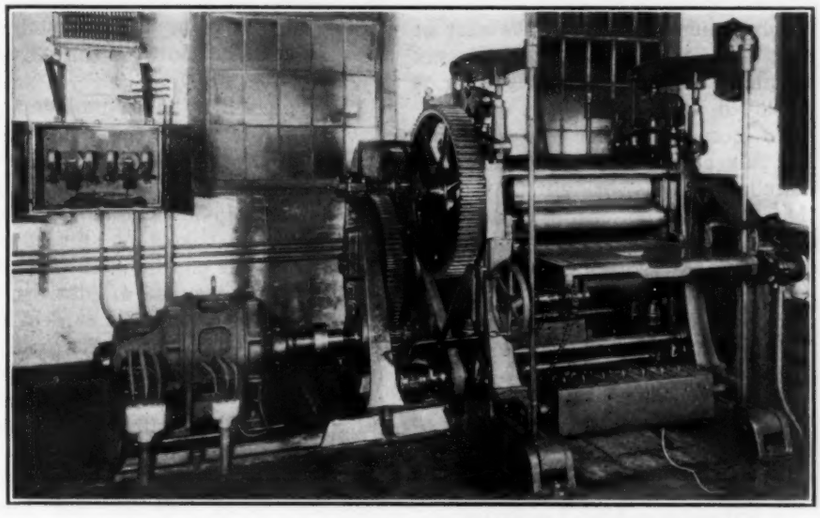
that the machine is in proper condition for operation.

**Starting Horizontal Turbines**

1. Receive and answer the signal "Slow" from the switchboard operator.
2. Start the circulating pump.
3. Open the air relief valve on the discharge end of the condenser and close it when water begins to overflow.
4. See that all drains on the turbine are open.
5. Start the auxiliary oil pump for the bearings and governor.
6. Turn on the cooling water to the main bearings and oil cooler.
7. Turn on steam to the seals of the turbine.
8. Close the vacuum globe valve on the condenser.
9. Put on the condenser air ejector until 10 in. to 15 in. of vacuum is reached.
10. Start the air pump.
11. Shut off the condenser air ejector.
12. Start the hot-well pump.
13. See that oil and water are circulating to all the main bearings and use as little water as possible to keep the bearings within the desired temperature limits.
14. See that the governor is being supplied with oil.
15. Examine all gages and see that the steam gage shows proper pressure, the vacuum gage shows proper vacuum and the oil and water gages show proper pressure.
16. Open the throttle until the turbine starts to revolve. Watch the first stage pressure gage, which should register 15 lb. to 18 lb. Maintain this pressure until the machine turns over.
17. As soon as the machine turns over reduce the throttle opening to the point just necessary to keep the machine turning over slowly until it has warmed up. Note.—The time allowance for warming up should be approximately one minute per 1,000 kw. capacity.
18. Signal "Slow" and receive an answer from the switchboard operator.
19. After receiving and answering the signal "Speed" from the switchboard operator, open the throttle until the first stage pressure is 0 lb. and maintain this pressure until the machine comes up to speed, as indicated by the speed indicator on the gage board, by the closing of the admission valves by the governor, and by the reduction of the first stage gage pressure below 0 lb.
20. If the turbine has water seals, admit a small amount of water to the seals at approximately half speed; then, as the speed increases, increase the amount of water and reduce the amount of steam to the seals until the steam is entirely shut off. These adjustments must be made carefully, in steps small enough to avoid sudden temperature changes or blowing of water from the seals by high steam pressure.
21. Open the throttle wide, noting that no increase takes place in the first stage pressure or in the turbine speed, as indicated by the frequency meter.
22. Trip the throttle by hand.
23. Reset the throttle trip (for governor control).
24. Open the throttle wide, not exceeding 0 lb. pressure on the first stage, until the machine comes up to speed, as indicated by the speed indicator on the gage board, by the closing of the admission valves to the governor, and by the reduction of the first stage gage pressure below 0 lb.
25. Make general inspection of the oil from bearings and of all gages.
26. Signal "Load" to the switchboard operator and receive answer. Note.—The load should be increased at the rate of approximately 1,000 kw. per minute.
27. See that the steam valves are open on the auxiliary oil pump and that it is under governor control.
28. Close the turbine drains.
29. As the load increases regulate the amount of steam supplied to the seals.

## Individual Drive in Paper Mill Effective

TO ELIMINATE belts, countershafts, oil bearings, etc., of belt-driven paper platers, the individual motor-driven plater shown herewith has been developed. The paper mill in which this equipment was installed increased its production on this particular plater by 20 per cent after the replacement of the belt drive by the reversing-motor drive.



INDIVIDUAL DRIVE FOR PAPER PLATER INCREASES PRODUCTION 20 PER CENT

The drive is simple, rugged and compact. The phase-wound reversing motor has high torque characteristics and is mounted on a bedplate common to the plater and coupled to the plater pinion shaft. The external rotor resistance assists in keeping the motor cooled by dissipating outside of the motor much of the heat of the reversal. The control consists of three units, namely, a three-position master switch, a cabinet-inclosed contactor panel and an oil-circuit-breaker primary switch. The small drum controller, or master switch, with one forward, one reverse and one off position, is mounted on the end of the plater table with a short piece of flexible conduit attached to allow the table to be raised or lowered. The length of the travel of the switch handle is very short and therefore does not tire the operator's wrist. This master switch controls the two magnetically operated contactors of the contactor panel. The contactors are mechanically interlocked, one furnishing power to drive the plater forward, the other to drive the plater in the reverse direction.

As the duty of the reversing plater drive is rather heavy, the equipment is made rugged to withstand this type of service. Ordinarily the plater is reversed from ten to twenty times a minute, but when starting to plate a thick "book" that is full of air the reversals may reach a frequency of thirty to the minute. The shorter time of reversal and the increased speed of the rolls made possible by direct motor drive permitted an increase of 20 per cent in the production of this machine. The particular 36-in. plater shown, having 17-in. diameter rolls and operated at 20 r.p.m., plates seventy-two books of very high-grade bond in two and one-half hours with an energy consumption of 10.8 kw.-hr. when plating 41-lb. paper.

A. F. PAIGE.
Westinghouse Electric & Manufacturing Company,
Springfield, Mass.

## Automatic Circuit Breakers Reduce Maintenance

THREE automatic reclosing circuit breakers have been in service for three years at a substation of a steel company in Pennsylvania without requiring any repair expense. During this period the only trouble has been a slight corrosion on the contacts of the reclosing solenoid, which was very easily remedied.

These 250-volt breakers are installed in a motor-generator substation and provide protection to various feeder circuits. Two of the breakers, rated at 5,000 amp., are used on a generator circuit and a feeder circuit to a 400-ft. double trolley gantry crane in the coal-storage plant. The other breaker, having a capacity of 2,000 amp., is placed on a feeder circuit to another part of the plant. The switch duty has not been severe, since under the worst conditions the breakers have not opened more than three to four times a week.

The substation attendant also takes care of outside electrical repairs and the maintenance of the crane, and therefore these reclosing breakers save much time which he would otherwise have to spend in resetting tripped breakers by hand. This saving has aided in paying the cost of the installation. The station is not automatic since a manual starter is employed.

To increase further the protection for this crane, limit switches were installed on the bridge runway so that, should the crane control become stuck, the bridge itself would open the track limit switch. This switch being connected in series with the circuit-breaker solenoid in the substation, the breaker would then trip, thereby stopping the bridge before it struck the bumpers.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

## Effective Oil-Testing Apparatus

THE arrangement of apparatus shown herewith was devised to test the insulating properties of oil used in large high-voltage transformers to determine when the oil had been sufficiently dehydrated. The outfit takes the place of an expensive oil-testing outfit, and, although it is lacking in a number of refinements, it will accurately detect the presence of moisture in the oil in the most minute quantities. It is made up of apparatus usually carried in stock by the central station, and this apparatus may be returned to stock when the testing has been completed.

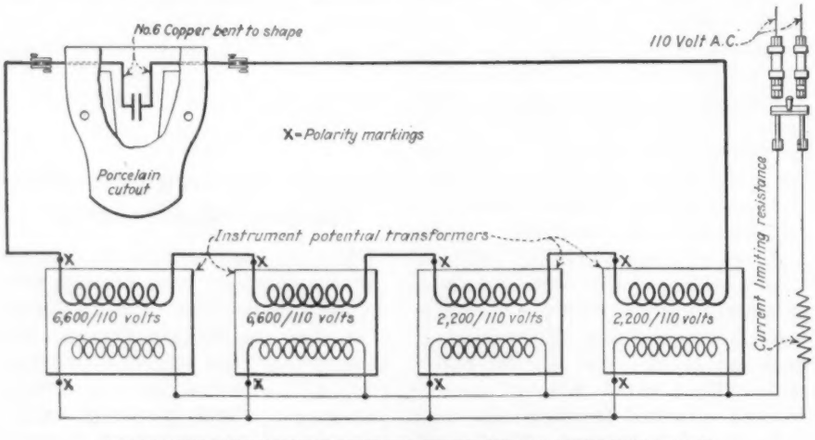
### PLUG CUT-OUT FOR OIL HOLDER

The illustration shows the apparatus as it was used. An inverted porcelain plug cut-out is employed as an oil cup. In it are mounted the two electrodes which form the spark gap. These consist of two pieces of sheet copper, cut 1 in. square, soldered to pieces of No. 6 copper wire and spaced 0.1 in. apart. They are rigidly held in place by the terminal screws of the cut-out. A convenient gage for the gap is a piece of bare No. 10 wire which has a diameter of 0.1018 in. It is essential that the gap be accurately gaged, but when once set it needs no further adjustment. The gap is mounted so that it will be 1 in. below the surface of the oil when the cup is filled with oil. A glass pipette, made of glass tubing, is used to empty the cup. The potential of 17,200 volts effective, or approximately 25,000 maximum, was supplied by two 6,600/110-volt and two 2,200/110-volt instrument potential transformers. The high-voltage windings are connected in series with the spark gap and the low-voltage windings in parallel through a low current-limiting resistance. A 6-lb. flatiron element served this purpose.

The practice followed was to first test the oil from the bottom of the transformer. In nearly every case this oil will break down; however, if it does not, the oil receives no further attention. If the oil from the bottom breaks down under test, a sample is then taken from the top. If this sample breaks down, the oil is in a dangerous condition, and the entire amount in the transformer must be dried at once. In case the oil at the top does not break down, as is usually the case, oil is drained from the bottom until a sample is obtained that stands up under the voltage test. The quantity drained out is then dehydrated until it stands up under test, when it is placed back in the transformer.

By following this procedure it was found that much unnecessary work was eliminated, owing to the fact that only the oil needing attention is worked on. RALPH PITTMAN.

Pine Bluff Company,
Pine Bluff, Ark.




APPARATUS ACCURATELY DETECTS PRESENCE OF MOISTURE IN OIL IN MINUTE QUANTITIES

## Cost of Installing 5,000-Kva. Transformers

A NEW ENGLAND central-station Company purchased and installed during 1922 three 1,667-kva. transformers for stepping up the voltage at a 13,200-volt bus to 22,000 volts in order to meet the demands of increased business on a trunk-line feeder. The itemized cost of this work is given in the accompanying table.

EXPENSE OF INSTALLING TRANSFORMER BANK

| | Per Unit | Total |
|---|---|---|
| Three 1,667-kva. units, per kva. | $2.50 | $12,531.25 |
| Busbar supports | ... | 37.34 |
| Iron oil drum | ... | 15.00 |
| No. 2/0 secondary cable 1,544 ft. | 0.1575 | 243.24 |
| No. 2 secondary cable, 1,112 ft. | 0.1068 | 118.76 |
| No. 6 weatherproof wire, 72 lb. | 0.154 | 11.09 |
| No. 2 weatherproof wire, 192 lb. | 0.1647 | 31.62 |
| Three-conductor cable, 205 ft. | 1.0729 | 219.95 |
| Twelve rolls tape | 0.1724 | 2.07 |
| Gasoline | ... | 0.48 |
| Two 4-in. iron clips | 2.00 | 4.00 |
| Four 13,000-volt pot-heads | 43.9222 | 175.69 |
| Twelve 4-deg. copper sleeves | 0.1733 | 2.08 |
| Wiping solder, 34 lb. | 0.1638 | 5.57 |
| Oxide, 2 gal. | 1.60 | 3.20 |
| Three cans "Conduline" | 2.32 | 6.96 |
| Two cans "Condecell" | 4.33 | 8.66 |
| One can asphaltum | ... | 1.53 |
| Two rolls tape, No. 355 | 0.789 | 1.58 |
| Two ½-lb. conduletes | 0.385 | 0.77 |
| Four 3-amp., 600-volt fuses | 0.2187 | 0.87 |
| Four 30-amp., 600-volt fuses | 0.483 | 1.93 |
| Solder, 2 lb. | 0.2729 | 0.55 |
| Miscellaneous material | ... | 21.21 |
| Freight | ... | 206.19 |
| Teaming | ... | 154.00 |
| Transportation by company | ... | 32.89 |
| Payroll, labor, per kva. | 0.105 | 523.80 |
| Total, per kva. | $2.87 | $14,362.18 |

FIELD EDITOR ELECTRICAL WORLD.
Boston, Mass.

# Central Station Business

**Advertising, Selling and Service Methods**
**Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences**

## Advantages of Machine Billing*

### Simplified System Reduces Clerical Help from Seven to Five and Produces 340 Bills Daily—Machines Speed Up Billing Operations

By Indmann P. Marking
Chief Clerk Wisconsin-Minnesota Light & Power Company, La Crosse, Wis.

ON AUG 1, 1922, our company's gas, electric and merchandise accounts, numbering between eight and nine thousand, were transferred from a form of bookkeeping using the Boston style of ledgers to an entirely different form using machine billing and bookkeeping machines and loose-leaf ledgers. At first hand this would appear to be a big job and one to be viewed with some misgivings. However, many test billings were made in order to determine the maximum number of bills, both gas and electric, that could be put through the billing machine in an hour's time. Test runs were also made to determine the number of debit and credit postings that could be made on the posting machine in the same period. A special form of ledger sheet suitable for keeping gas and electric accounts was prepared. It was also necessary to prepare a different form of bill with the spacing entirely different from the old form. After many tests had been made, we were in a position to see that the installation of one billing machine and one posting machine would enable us to reduce the clerical force by two. The accompanying comparison shows the different office clerks before and after the system was installed, together with an outline of their duties.

It will be noted that under the new system five clerks are doing the work which required seven under the old system. Approximately 13,500 gas and electric meters are read and billed through our office monthly. Assuming that there are twenty-five working days in the month this means that 540 meters are read daily by two meter readers. If we were to have a billing on gas and a billing electricity on every bill that is sent out, the number of bills we send out each month would be 6,750. But all of our consumers do not have both gas and electric service. We have made a check and have found that only 25 per cent of the bills leaving our office show a billing for electric or gas service alone; therefore approximately 8,500 bills are sent out monthly. On the basis of twenty-five working days to the month we send out 340 bills daily in order to keep up our billing. A table giving the time necessary for each step of approximately one day's billing follows:

| | Hours | Minutes |
|---|---|---|
| 300 bills through addressograph.. | .. | 20 |
| 300 bills through billing machine. | 1 | 45 |
| 300 bills, rubber stamping..... | .. | 30 |
| 300 bills, getting predetermined total..... | .. | 40 |
| 300 bills posted to ledger..... | 3 | .. |
| 300 bills, entering merchandise amounts due..... | .. | 15 |
| 300 bills, totaling..... | .. | 20 |
| Total time..... | 6 | 50 |

Meter reading commences on the last day of the month except when the last day falls on Sunday. Readings are turned in to the office each day, which gives the billing department the opportunity of billing on the day following the meter reading.

*A paper presented before the Accounting Section of the Wisconsin Utilities Association, Milwaukee, March 23, 1923.

WISCONSIN-MINNESOTA LIGHT & POWER CO. LA CROSSE
**RESIDENCE LIGHTING AND GAS BILL**

502 MR. JOHN JONES.
910 STATE ST.
CITY

DISCOUNT ALLOWED IF PAID ON OR BEFORE

RESIDENTIAL LIGHTING (A)
Present Reading MAR 19 1550
Previous Reading FEB 19 1542
Difference 8
Meter Constant 10
CONSUMPTION 80 KWH

COMMERCIAL GAS
Present Reading MAR 19 472 00
Previous Reading FEB 19 400 00
Difference 72 00

It takes time to make duplicate bills. Please bring this bill with you. Failure to receive bill does not entitle consumer to discount.

Unless self-addressed envelope is furnished for return of receipted bill it will not be mailed. Your check is your receipt.

| | Gross | Discount | Net |
|---|---|---|---|
| First 50 KWH.....@ 12c | | | |
| Next 50 KWH.....@ 9½c | 8.85 | .50 | 8.35 |
| Balance ..... @ 8c | | | |
| Unpaid balance previous month | | | |
| TOTAL RESIDENCE LTG. .. | | | |
| Minimum ..... Lt. Meter | | | |
| First 5,000 cu. ft.....@ $2.15 | | | |
| Next 5,000 cu. ft.....@ $2.00 | 15.15 | .72 | 14.43 |
| All over 10,000 cu. ft.....@ $1.90 | | | |
| Unpaid balance previous month | | | |
| TOTAL COM'L. GAS ..... | | | |
| Merchandise Account ..... | | | |
| TOTAL BILL ..... | | | 23.78 |

Discount allowed if paid on or before .....

502 MR. JOHN JONES.
910 STATE ST.
CITY

Enclose this stub when mailing check

| | Gross | Discount | Net |
|---|---|---|---|
| Residence Lt'g ..... | | | |
| Current Bill ..... | 8.85 | .50 | 8.35 |
| Unpaid Balance ..... | | | |
| Total Residence Lt'g ..... | | | |
| Commercial Gas ..... | | | |
| Min. ..... Lt. Meter | 15.15 | .72 | 14.43 |
| Current Bill ..... | | | |
| Unpaid Balance ..... | | | |
| Total Com'l Gas ..... | | | |
| Merchandise Acc't ..... | | | |
| TOTAL BILL ..... | | | 23.78 |

FIG. 1—COMBINED RESIDENTIAL LIGHTING AND GAS BILL FORM
Figures are posted on this form directly from the billing machine.

Streets running north and south are read first, commencing on the north end of the first street and finishing at the extreme south end. Street No. 2 is commenced on the south end and worked north; then street No. 3 is commenced on the north end and worked south. After all the streets running north and south have been read, the streets running east and west are worked in a similar manner. Addressographing bills takes only a few minutes each day and is taken care of by the man who distributes bills. It is his duty to see that there are at all times enough bills printed ahead to supply the billing department for three or four days.

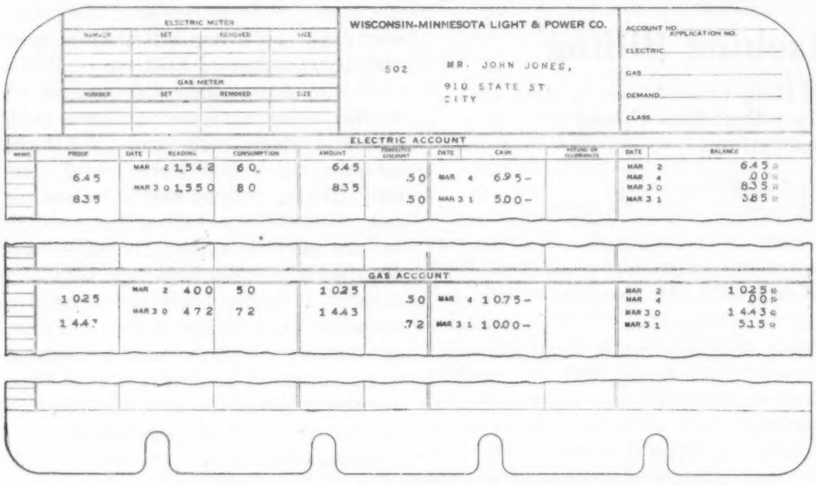

ELECTRIC METER
NUMBER SET REMOVED SIZE
GAS METER
NUMBER SET REMOVED SIZE
WISCONSIN-MINNESOTA LIGHT & POWER CO.
502
MR. JOHN JONES,
910 STATE ST.
CITY
ACCOUNT NO. APPLICATION NO.
ELECTRIC
GAS
DEMAND
CLASS
ELECTRIC ACCOUNT
MEMO PROOF DATE READING CONSUMPTION AMOUNT PREMISES DISCOUNT DATE CASH MEMO OR ALLOWANCES DATE BALANCE
6.45 MAR 2 1,542 60 6.45 .50 MAR 4 6.95- MAR 2 6.45
MAR 30 1,550 80 8.35 .50 MAR 31 5.00- MAR 4 .00
8.35 MAR 30 8.35
MAR 31 3.85
GAS ACCOUNT
1.025 MAR 2 400 50 1.025 .50 MAR 4 10.75- MAR 2 1.025
MAR 30 472 72 1.443 .72 MAR 31 1.000- MAR 4 .00
1.447 MAR 30 1.443
MAR 31 .515

FIG. 2—LEDGER SHEET FOR BOTH ELECTRIC AND GAS ACCOUNTS, WITH SPACE FOR METER DATA

The billing machine used has six columns of figures which can print meter readings up to 999,999. After the bill has been properly placed in the carriage of the machine to have the electric meter readings printed, the operator presses down the respective keys for the month, day of month and present meter reading. Then she operates the touch bar and the machine prints the date and meter reading thus: "March 2, 545." The machine then automatically moves the bill up one space. The operator now presses the respective keys for the month, date and figures of the previous meter reading. Then comes the final operation, which is to operate the touch bar for the second and last time. This prints the month, date and previous meter reading and at the same time subtracts the meter reading and prints the difference. The operator next pulls a lever attached to the carriage of the machine; this operation moves the bill into a position for printing the meter readings, differences and dates. Only one motion of the lever is necessary to do this. Fig. 1 shows the residence electric and gas bill form and indicates the meter reading data as printed by the billing machine.

It will be noted that the billing form has been designed so that there is enough space under both electric and gas for two sets of meter readings, which might be necessary because the consumer has two electric or two gas meters, or because the meters have been changed during the month. If the electric meter carries a constant as shown on the bill, it can be printed by the machine, but two extra operations of the machine are necessary to do this.

### RUBBER-STAMPING THE DISCOUNT

The next step in the making of the bill is to insert the gross amount, discount and net amount. Rubber stamps for both electric and gas consumptions have been made for this purpose. They are of a special size to fit the spacing on the bill and print the required information in this manner:

3.00 .25 2.75

These stamps are arranged in convenient order in a flat box, 12 in. x 17 in. x 2½ in., where they rest on an ink pad placed in the bottom of the box. There is a stamp for each step of electric consumption up to 100 kw-hr. and for each step of 100 cu.ft. up to 10,000 cu.ft. of gas. The stamps are numbered according to the consumption, so that if the billing clerk wishes to bill the amount of a consumption of 25 kw.-hr. and of 5,100 cu.ft. of gas, she merely reaches for the electric stamp No. 25 and the gas stamp No. 51. Both the consumer's portion of the bill and the cashier's stub are stamped.

Electric bills on the commercial lighting rate, which involve figuring "thirty hours' use" of the maximum demand, are not stamped, but the amounts are filled in with pen and ink. We have, however simplified the method of figuring these commercial bills by preparing a chart giving the net amount of all bills where the thirty hours use of the maximum demand is less than 100 kw.-hr. This chart has been placed on a revolving drum and is very convenient for the billing clerk.

The next step toward completing the bill, that of taking the predetermined total, is very simple and is done by the telephone operator. She takes off on an adding machine the consumption and net amount of the residence lighting bills, the commercial lighting bills and the gas bills—separating the residence gas from industrial gas. This predetermined total is used for checking the entries made on the ledgers by the posting clerk, and when found correct it is filed away for future reference. Fig. 2 is a specimen of the ledger sheet. In the upper left-hand corner space is provided for three electric and three gas meter charges; the name and address are placed at the top in the middle, and in the upper right-hand corner are the account number, class of consumption, rate and so forth.

Below this information the electric and gas entries are made in the col-

CLERICAL FORCE REQUIRED

| Prior to New System | | After New System | |
|---|---|---|---|
| Kind of Clerk | Duties | Kind of Clerk | Duties |
| Assistant chief clerk | Assisted in billing and balancing | Assistant chief clerk | Balances ledgers |
| Billing clerk | Figured all gas and electric bills and operated addressograph | Billing clerk | Figures all gas and electric bills |
| Ledger clerk | Entered all gas and electric bills | Posting clerk | Enters all gas, electric, merchandise, power and heat bills. Posts all cash |
| Cash and balance clerk | Posted cash and balanced books | Power and merchandise clerk | Bills all merchandise and power |
| Merchandise and heat clerk | Billed and entered merchandise and heat | Bill distributor | Distributes bills and operates addressograph |
| Power clerk | Billed and entered power | | |
| Bill distributor | Distributed bills | | |

umns provided. This ledger sheet can be used on both sides and will easily accommodate twenty-six debit or credit postings for both electric and gas on one side of the sheet. These sheets are contained in substantial binders holding between 550 and 600 sheets separated into lots of fifty by index files having the number on a tab at the top and staggered so as to be readily observed.

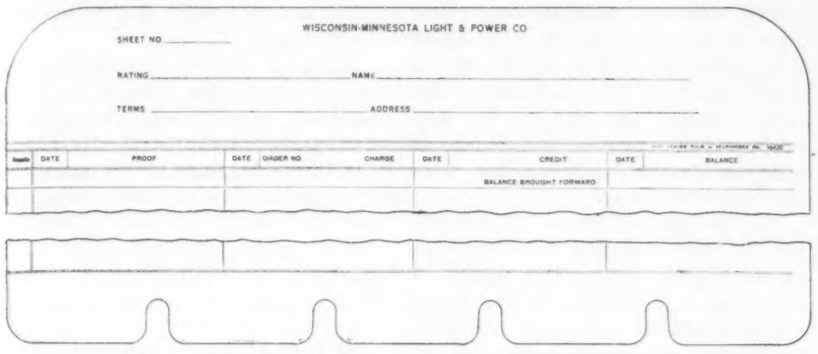



FIG. 3—LEDGER FOR MERCHANDISE ACCOUNTS

### Posting Debits

The operator of the posting machine places the bills to be entered at her left, and the ledger binder is placed in a rack at her right She first looks at the bill to get the consumer's name and address, then out of the binder the corresponding ledger sheet and places it in the posting machine. She first carries forward the balance—if there is one. If not, the touch bar is operated and the carriage with the ledger sheet moves to the next column. Then the meter reading and the consumption are entered. The amount of the charge is then entered and the carriage with the sheet moves to the left so that the right-hand balance column moves into position. The total key is held down and the touch bar operated, thereby totaling the amount owed by the consumer, including the old balance and the new charge, to be printed in the right-hand column. If the consumer is in arrears, these items are written on the bill in pen and ink by the posting clerk and then the bill is totaled. This total must check with the amount shown in the right-hand balance column of the ledger sheet. The ledger sheet is then put back in the binder and is set out to the right, showing that there has been a charge made against that particular account. After all charges are made for one route, they are compared with the predetermined total, and if found correct, the sheets are set back in place in the ledger binder.

After the merchandise amount due has been inserted in the proper place on the bill, it is ready to be totaled and dated. In very few cases are bills mailed, this being done only by special request of the consumer. We have found that distributing our bills is more satisfactory to the consumers and is cheaper than mailing. Fig. 3 shows the ledger sheet used for merchandise accounts. When changing the posting machine from the electric and gas consumers' ledger sheet to this sheet we merely change the control and stop bars which determine the spacing of the machine.

### Posting of Cash

It has already been mentioned that it takes three hours to enter the debits of 300 gas and electric bills. The forenoon of each day is devoted to this work and the afternoon is devoted to the posting of cash credits. Our cash is closed at 10 o'clock each morning, when the cash is balanced and the bill stubs totaled by the cashier. As soon as the cashier finds her total, the stubs are given to the telephone operator, who sorts them as to light and gas, power and merchandise. They are again sorted as to street and account number and divided into lots according to the different ledgers. A separate total is taken for each ledger, and the grand total of these totals must agree with the cashier's total. As soon as this has been done the cash credits are ready to go to the ledgers. The posting of cash to 300 accounts takes considerably more time than does the posting of charges to this number. This is due largely to the fact that the debits for one day are entered in one or possibly two ledgers, whereas it is not at all uncommon to have to open each of the sixteen ledgers in order to post one day's cash.

The new system has worked out very satisfactorily. It has increased the efficiency of our office work, besides reducing the number of clerks. Less office space is required as the five Boston-style ledgers were very bulky and took up a great deal of desk room when open, while the sixteen new-style ledgers are kept on two portable racks. The new system makes for greater neatness and accuracy of accounts as well as of bills. The employees are better satisfied and find it easier to handle the new-style ledgers as they are much lighter in weight.

## How Far Practical Home Electrification May Be Carried

ELECTRIFICATION of the home of the average customer depends largely upon his financial ability to purchase and the amount of advertising and sales effort expended by the central station company. How far it is possible for an electrical man to go with the installation of useful electrical devices is very well illustrated in the equipment of the home of E. S. Lincoln, consulting engineer, in Portland, Me. Following the appliance contest conducted by *Electrical Merchandising* during the N. E. L. A. convention in New York, Mr. Lincoln has written the ELECTRICAL WORLD describing the electrical equipment which he has in every-day use in his home.

Mr. Lincoln did not participate in the contest mentioned, and his remarks are particularly significant to central-station men as they indicate the possible extent of practical home electrification. His letter reads in part as follows:

"I have always been a liberal user of appliances, and in my laboratory I have made thousands of tests on devices of every kind. At the present time I am pretty well electrified in my own home, as you will see by the following description:

"My service is underground, consisting of a three-phase and single-phase three-wire service. The supply is from one set of transformers through two independent conduits. Heavy wire is used, as my house sets back about 200 ft. from the street. This service is measured by three meters; one is for light, one for power, and the third for heating and cooking.

"For lighting, I use eighty-five lamps, practically all of which are

controlled by push switches. There is not a dark space in the entire house, lights are provided in all closets, hallways and so forth. In the owner's room is a switch which controls a sufficient number of lamps to give illumination of the entire house in case of necessity. Tell-tale lights are used in the basement, attic and other places where lights are liable to be forgotten. Besides the lighting system, electricity is used for cooking and hot water heating.

"There are twenty-one outlets in various parts of the house for using electrical appliances. Special plugs are provided in the kitchen and dining room for the common appliances. As I have virtually all the appliances manufactured, many in duplicate, I will not go into this list in detail.

"Electricity is used in my home for freezing ice cream, operating the phonograph motor, a moving picture machine and a stereopticon. I have a small shop which is operated by a motor, and our water pumping is also done electrically as we are several miles from the city water supply.

"My wireless telegraph outfit is installed permanently, wires being concealed and terminating at plugs. It is possible to plug a phone or a loud speaker in any part of the house. My boys, in their play room, have an elevated electric railroad of 2-in. gage, consisting of 160 ft. of track together with automatic signals, switches and lights. We also have a few interior telephones as well as the ordinary electric bells and alarm systems.

"In the garage there is a charging set for charging batteries and an electrically driven tire pump. I also have a laboratory in the house which contains a lot of electrical equipment. As we are somewhat out of the city I find it necessary to use a storage battery in case the service is 'off' for any length of time, but fortunately this is not called into use more than once or twice a year.

"I have considerable special lighting equipment for photographic purposes such as high-powered tungsten lamps, arc lamps, etc.

"At the present time I am in the process of installing an electrically driven refrigerating outfit, so that I feel we are pretty well up to date electrically."

None of this equipment appears unnecessary to Mr. Lincoln, and it is not made up of "freak" installations or useless contraptions. He has in this electrification of his home set an example which many central-station men would do well to emulate if they expect to convince their customers of their sincerity in preaching the gospel of the home electric.

## A Graphic Picture of a Utility's Development

"A CITY CAN PROGRESS ONLY AS FAST AS ITS PUBLIC UTILITIES CAN DEVELOP".
"LA RAPIDITÉ DU PROGRÈS D'UNE VILLE EST EN PROPORTION DU DÉVELOPPEMENT DE SES UTILITÉS PUBLIQUES".
1903 17 900 HP.
1908 28 870 HP.
1913 68 400 HP.
1918 234 000 HP.
1923 275 000 HP. (ESTIMATED)
20 YEARS ELECTRICAL DISTRIBUTION DEVELOPMENT OF THE MONTREAL LIGHT, HEAT & POWER CONS.
20 ANNÉES DE DÉVELOPPEMENT DE DISTRIBUTION ÉLECTRIQUE DE LA

TO VISUALIZE to the public how its service has developed during the past twenty years the Montreal Light, Heat & Power Consolidated is displaying in its office a painting which is shown in the accompanying illustration. The company serves a large industrial load in and around Montreal, Que., and the growth of the company's business is depicted by a workman of increasing size at the end of each five-year period. In 1903 the company's power load was only 17,900 hp., while during 1923 the total connected load is expected to reach 275,000 hp.

The painting also serves to remind people in both French and English that "a city can progress only as fast as its public utilities can develop."

## What Other Companies Are Doing

**Cleveland, Ohio.**—The Electrical League of Cleveland has been conducting an electrical home contest among the wives of the electrical men of that city for the complete electrification of their homes. Six prizes of $10 each were awarded for the best electrically equipped homes.

**Denver, Col.**—During the recent "Better Homes" show in this city a night was given to the Electrical Co-operative League at which the electrical idea was featured. More than three hundred electrical men and their families were in attendance at the closing session. The idea of electrification was injected into every feature of the show—in wiring, lighting and equipment in the modern rooms, convenience outlets, etc.

**Wallingford, Conn.**—Eighty electric ranges are now in service on the lines of the local lighting department, and A. L. Pierce, superintendent, states that from four to six ranges averaging 8 kw. connected load each can be wired from one 10-kw. transformer on account of the excellent diversity factor. For electric range service the customer is billed at the rate of 3.5 cents per kilowatt-hour for the first 100 kw.-hr., the excess being billed at 3 cents per unit. Even the poorhouse at Wallingford is equipped with an electric range.

**Davenport, Iowa.**—Life insurance policies totaling $150,000 were presented to employees of the People's Light Company recently at their annual picnic. A policy was given to each employee whose term of service exceeded six months. They averaged about $1,000 each.

# Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

## Hydro-Electric Development and Steam Equipment

*Lago Bianco Reservoir.* — FILIPPO ORSATTI.—This reservoir consists of the joining of two lakes (Lake Bianco and Lake Scala) which are about 7,300 ft. above sea level. By damming at the opposite extremities of the two lakes, the waters join, forming one single large reservoir. The water level may be raised or lowered 18 ft. above or below the normal, thus providing a natural reservoir giving a reserve water supply of 350,000,000 cu.ft. The outlet, the construction of which is given in accurate details, was artificially located at the middle of the reservoir by the construction of a special well and a tunnel cut through the rock. Owing to the altitude of the two lakes the work presented numerous difficulties which are illustrated and discussed.—*Ingegneria*, Vol. II, No. 3.

*Efficiency of Steam Plants with Very High Pressure.* — H. GLEICHMANN. — The author assumes an existing steam plant, operating at 16 atmospheric pressure, and investigates the theoretical possibilities and efficiencies resulting from an increase of the boiler pressure to 101 atmospheres, driving with this high pressure a turbine, the exhaust of which would drive under a pressure of 16 atmospheres the existing turbine. Assuming the output of the present plant to be 10.000 kw., the high-pressure set could deliver 4,400 kw. at an investment of about the same amount as a new 4,400-kw. set built for operation on 16 atmospheres. The cost of the high-pressure turbine would be somewhat less, that of the boilers somewhat more, and the pipe lines, which can be smaller but have to be heavier, cost about the same as the corresponding parts for 16 atmospheres. Efficiency charts show the effect of an intermediate superheater between the two turbines and the financial gain achieved with this system.—*Siemens Zeitschrift*, June, 1923.

*Collecting Cinders from Flue Gases.* —L. B. SALT. A combined induced-draft fan and cinder collector is described. In this unit a pocket is built in the blades of the fan with inclined channels leading into dust chambers in the side of the housing where the cinders caught in the pocket can settle. Two such fans used by the Interborough Rapid Transit Company (New York) have shown excellent results both for cinder elimination and air efficiency. Each of these fans handles the gases from six 500-hp. boilers, and during a run with the boilers at 200 per cent of rating collected 250 lb. of cinders an hour. Other installations of these combined units are also described.—*Combustion*, June, 1923.

*Graphic Method for Computing Heat Balance.*—F. A. SHORKEY.—The author has devised a series of charts with a view of eliminating sources of error and the lengthy calculations for making a heat balance, and also to facilitate and expedite the calculation of these balances. A chart is presented for the determination of hydrogen, and one for the determination of volatile carbon. Several charts are also given showing the losses due to moisture, burning of hydrogen, combustible in ash and sulphur correction, dry flue gases, and CO in dry flue gases.—*Blast Furnace and Steel Plant*, June, 1923.

## Transmission, Substations and Distribution

*Swiss Outdoor Substation.*—After very careful investment and operating cost comparisons, the Swiss Federal Railways decided in favor of an outdoor substation for one of its branches of electrified roads. This station, with a total and continuous output of 10,000 kva., serves to step two incoming single-phase, 60,000-volt, 16⅔-cycle lines down to the railway overhead voltage of 15,000. Three self-cooled 3,000-kva. conservator-type transformers and one identical spare unit, with the necessary switching, measuring and protective apparatus, are installed in a large yard next to the railway tracks. To keep the oil in switches and transformers in good condition a central filtering plant has been provided in the remote-control switch house, which also contains a well-equipped general repair shop. A complete wiring diagram, station layout and general views of the yard illustrate the paper.—*Bulletin Oerlikon*, April, 1923.

*Short Circuit Forces in Transformers—II.*—J. BIERMANNS.—The first installment of this article contained the complete derivation of fundamental equations for the calculation of mechanical forces in a transformer under short circuit. In the second and final part is shown how to compute radial and axial stresses if a short-circuit occurs across the terminals or only across a part of the winding of a transformer with concentric arrangement of low and high-voltage coils. The transitory character of the forces is then explained, distinguishing between the initial short-circuit current rush and the stationary or damped part of it. The effect of these forces upon the winding itself and its supporting structure is then investigated, assuming a certain amount of assymmetry between the primary and secondary, such as is unavoidable in the course of design and assembly. On an actually built 20,000-kva., 110,000 / 6,000-volt, 50-cycle Y-delta transformer all the above calculations are illustrated with concrete values.—*Bulletin de l'Association Suisse des Electriciens*, May, 1923.

*Poles of Reinforced Concrete Centrifugated.* — A 75,000-volt transmission line built with poles of reinforced concrete centrifugated is described in this article, which also shows how the poles are manufactured. A previously built steel armature is placed in a wooden form which is half filled with concrete. This assembly is made to rotate at 600 r.p.m. to 1,000 r.p.m. by a centrifugal machine until the concrete obtains a good set. This operation lasts about ten minutes. After the form has been removed the pole is kept under wet sand for seven to eight days. — *Sincronizzando*, May, 1923.

## Units, Measurements and Instruments

*Dielectric Research.*—JAMES MOULD. —The author considers the variations of dielectric constant with frequency and energy loss in standard dielectrics. The materials selected were ebonite, glass, micanite, india rubber, gutta percha, etc. The author also measured the energy loss in these dielectrics at various frequencies with a view to the possible analysis of the loss into its various parts.—*Beama*, June, 1923.

*Technical and Commercial Aspects of Power Factor.*—H. E. YERBURY.—The author considers the reason for low power factor in machines and apparatus as commonly used, the means that are available at the present time for improving the existing conditions and what can be accomplished in the reduction of charges as affecting the supplier and consumer. He states that the highest possible efficiency of an electrical undertaking can be obtained only by studying all the factors which at present militate against a low selling price per unit. The low average power factor existing on many undertakings could be raised and consumers should be encouraged to improve their power factor by the establishment of the principle of rebate for a high power factor.—*Journal of the Institution of Electrical Engineers (England)*, June, 1923.

*Dielectric Strength Ratio Between Alternating and Direct Voltages.*— J. L. R. HAYDEN and W. N. EDDY.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A.I.E.E. summer convention, July 7, on page 15.—*Journal of the A.I.E.E.*, July, 1923.

*Measurement of a Single-Phase Load at a Low Power Factor.*—A. DOVJIKOV. —The author considers the measurement of single-phase loads at power factors below 5 per cent, enumerates the difficulties that are encountered and gives a remedy of how these can be overcome. He discusses errors due to inductance of voltage coil, eddy

currents in wattmeter, effect of resistance of voltage coil, etc.—*Electric Journal*, July, 1923.

## Illumination

*The Electrical and Illuminating Equipment of the Eastman Theater and School of Music.*—F. A. MOTT and L. A. JONES.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A.I.E.E. spring convention, May 5, 1923, on page 1033.—*Journal of the A.I.E.E.*, July, 1923.

*Motion-Picture Protection with Incandescent Lamps.*—C. M. DOOLITTLE.—Cleanliness, economy, steadiness, quietness, softness of light, comfort and simplicity are the advantages of using incandescent lamps for motion-picture production. The construction of the lamp, special protectors, lamp-setting devices, automatic current regulator for alternating current and the field of application of the incandescent lamp are among the features discussed.—*Electric Journal*, June, 1923.

## Motors and Control

*Automatic Drive for Air Compressors.*—R. RÜCKERT.—For large compressed air supplies, where the compressor is driven by a three-phase motor, the maintenance of a steady pressure is difficult with a motor running always at the same speed. A system, where a by-pass on the compressor is opened when full pressure has been reached, causing the motor to run idle, is not desirable on account of the poor power factor of the motor during its no-load run. Best results have been obtained with a method, whereby the motor is pressure controlled, starting and stopping automatically when the air reservoir pressure is below or above a predetermined value.—*A. E. G. Mitteilungen*, May, 1923.

*Practical Details and Tables for Laying Out Motor Windings.*—A. C. ROE.—The author considers motors having twenty to twenty-four poles and shows where larger groups are placed in the windings which have unequal groups.—*Industrial Engineer*, June, 1923.

## Heat Applications and Material Handling

*Welding Machines for Mines.*—B. LETSCH.—For general repair work and the proper maintenance of its various power-driven machinery, a coal mine realized great savings from the installation of a stationary and a portable electric welding outfit. It is claimed that the investment of these welders paid for itself within a few months. The described equipment comprises a stationary welding plant with two 460/600-amp. generators, one portable 460/600-amp. welder on a four-axle car, a 150/225-amp. welder on wheels, and one 52-kva. resistance butt-welder. To enable the portable outfits to connect to either the 2,200-volt high-tension three-phase supply or the 550-volt direct-current trolley lines, they are each equipped with one alternating-current and one direct-current driving motor for the welding generator.—*A. E. G. Mitteilungen*, May, 1923.

*Heating a Cotton Weave Shed By Electricity.*—C. T. GUILDFORD.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A.I.E.E. spring convention, May 5, 1923, on page 1026.—*Journal of the A.I.E.E.*, June, 1923.

*Electric Brass Furnace Practice.*—H. W. GILLETT and E. L. MACK.—A 334-page report published to record the progress made so far in melting brass electrically. Its princpal purposes are to aid the plants which have not yet taken up such melting by pointing out the types of furnaces available, describing their performance and indicating their possibilities and their limitations, and to encourage further experimentation with and the development and installation of electric brass furnaces. A mass of very valuable information is gathered here and should be of the greatest value to users of brass furnaces or those intending to use them.—*Bulletin No. 202 of the Department of the Interior, Bureau of Mines.*

## Traction

*Automatic Train-Control Developments.*—Marked developments have been made in train-control equipment and the system described is designed to limit the speed of a train to any degree at any point. The fundamental principle consists of a time-element device on the locomotive operating in combination with pairs of inductors placed along the right-of-way, the spacing of the inductors determining the speed at which a train may pass the point in question without an automatic application of the brakes.—*Railway Electrical Engineer*, June, 1923.

*Locomotives for the Virginian Electrification.*—R. L. MCCLELLAN.—The electrification of this railway embraces 134 route-miles (213 miles of track) between Mullens, W. Va., and Roanoke, Va., and includes the district most difficult of operation because of the severe grades. A general description of the service that must be rendered on this road is given. The locomotives will weigh 600 tons and will develop 5,115 hp. at 14 m.p.h., and 5,970 hp. at 28 m.p.h. Current is collected by pantographs from an 11,000-volt trolley wire.—*Railway Age*, June 16, 1923.

*Financial Prospects of Railway Electrification.*—PHILIP DAWSON.—In this paper, presented before the Institution of Transport (England), the author gives the principal results of an investigation into the financial status of the electrification of the suburban line services at Brighton, Eastbourne and Worthing. He considers electric operation, increased traffic, gross receipts and expenses, results achieved by electrification and capital expenditures of various English systems.—*Electrician (England)*, June 1, 1923.

## Telegraphy, Telephony, Radio and Batteries

*The Electrical Plant of Transocean Radio Telegraphy.*—E. F. W. ALEXANDERSON, A. E. ROACH and C. H. TAYLOR.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A.I.E.E. summer convention, July 7, 1923, on page 21.—*Journal of the A.I.E.E.*, July, 1923.

*Railroad Signaling with Train Control.*—Three-indication color-light automatic block signals, operated by alternating current, together with ramps and control equipment for automatic train control, have been installed on 40 miles of single track between Charlottesville, Va., and Staunton, on the Chesapeake & Ohio. Operating difficulties on this stretch of track, special signal indications, signal layout protection at tunnels and economies effected by the signaling system are considered.—*Railway Age*, June 9, 1923.

*Influence of Motor Ignition Upon Radio Receiving on Airships.*—V. S. KULEBAKIN.—Radio reception on airships is seriously impaired by the emission of short wave lengths from the ignition system of the gas motor. This influence limits to a large extent the use of receiving amplifiers because they will amplify also the disturbance from the spark plugs. The author gives a description of the usual ignition systems and goes into very detailed theoretical investigations of the cause and the exact nature of these short wave emissions. A complete metallic shielding of the ignition apparatus of the engine, including all high-voltage and low-voltage connections, gives in most cases a satisfactory solution, but complicates the engines and makes them less accessible. A new system is mentioned, by means of which the amount of emitted electromagnetic energy is completely compensated, resulting in what is claimed to be absolute relief in all cases. The system itself, however, is not described.—*Elektrotechnische Zeitschrift*, June 7, 1923.

## Miscellaneous

*Mechanical Rectifiers.*—B. SCHAFER.—Synchronously vibrating mechanical rectifiers are described in this paper. These are capable of delivering singly or with two vibrators in parallel up to about 1½ kw. of direct-current energy, which is sufficient to feed projection arc lamps or to charge batteries. Tungsten contacts, careful tuning of the vibrator and condensers across the contacts insure a sparkless operation. It is claimed that these rectifiers are much cheaper than motor generators, and have at the same time a considerably higher efficiency. For an output of up to 6 kw. the author suggests the use of rotating commutators, driven by and mounted upon the shaft of a fractional horse-power, self-starting synchronous motor. Such a rectifier for a capacity of 5,000 watts direct current operates with an efficiency of more than 75 per cent.—*Elektrotechnische Zeitschrift*, June 14, 1923.

# News of the Industry

**Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men**

## Reproduction Cost

**Cannot Be Considered Controlling Element in Valuation, Says Wisconsin Supreme Court**

REPRODUCTION cost of public utility properties in Wisconsin cannot be considered as the controlling factor or even as a considerable factor in fixing the valuation of such properties for rate-making purposes by the State Railroad Commission, according to a decision handed down by Judge M. B. Rosenberry of the Wisconsin Supreme Court.

The decision was made in the case of the Waukesha Gas & Electric Company against the Railroad Commission of Wisconsin and directly involved the valuation of public utility property. His decision upholds the power of the Wisconsin Railroad Commission to fix rates for public utilities and justifies the commission in disregarding to a large extent the claim of replacement values made by utility companies in resisting demands for lower rates. In affirming the recent decision of the Circuit Court of Dane County, which restrained this company from increasing its electric rates here on the basis of a revised valuation of its properties, the state Supreme Court practically stabilizes the valuation of utility companies for rate-making purposes and does away with expensive revaluations and rate hearings.

The attitude of the Wisconsin court toward the theory that cost of reproduction should govern the fixing of values of public utilities is thus stated by Justice Rosenberry:

"With all due respect, the proposition that the cost of reproduction new, less depreciation, although it should no doubt be considered, is entitled to controlling or even considerate weight under present abnormal conditions appears to us to be unsound."

### Situation Not Clarified

The court points out that the United States Supreme Court, in three cases decided in May and June of this year, has not entirely clarified the situation as none of them contains a statement as to what weight should be accorded to the cost of reproduction new, less depreciation. One of these was the Southwestern Bell Telephone Company case from Missouri, which was interpreted at the time as upholding the reproduction cost theory of valuation.

Stating that it does not attempt to lay down a formula for valuing public utilities, the Wisconsin court says if it were to accord rank to the various factors to be considered in accordance with the weight to be given each in determining present fair value for establishing a rate base, such formula would be this:

1. Actual cost of plant when the investment has been prudently made.
2. Under normal conditions, cost of reproduction new, less depreciation. (When conditions are abnormal, cost of reproduction new, less depreciation, should be fourth).
3. Going concern value.
4. Working capital.
5. Other elements of value which may be presented in a particular case.

## Mexico Has Federal Power Commission

The Mexican government, according to a report to the Department of Commerce, has announced the organization of a National Commission of Motive Power (Comision Nacional de Fuerza Motriz), for the organization, development, planning and supervision of the commercial exploitation of the natural power resources of the republic. Studies will be made of the legislation in other countries relative to the developments of hydro-electric power and the generation and sale of electric energy.

The commission's program includes advising the government which bodies of water should be withheld from power exploitation, division of the principal rivers of the country into sections according to their respective possibilities for power or irrigation development, revision of the Federal or local tax laws which may hinder the establishment and operation of hydro-electric plants, study of the advisability of abolishing or modifying the present Federal tax on water concessions, study of the desirability of preserving, restricting or extending the privileges generally granted to power companies, assistance to power companies in obtaining subventions from the government when it is considered that these are for public interest, and the study, in co-operation with local authorities, of the desirability of electrifying certain railroad and street car lines.

It is planned also to exercise control and supervision over hydro-electric plants already functioning with a view possibly to revising the privileges which authorize the establishment of these plants. Similar plans will probably be developed where the energy is generated from sources other than hydraulic.

## Survey of Water Power

**Inventory of Water Power on Public Lands to Be Made by Interior Department**

A COMPLETE inventory of the water-power resources of the public-land states is being prepared under the program announced by the Department of the Interior. The surveys will form the basis for the classification of public lands with reference to their value as power sites.

Public lands reserved for use in connection with power sites and shown to be without power value will be recommended for restoration to entry. Lands that may be used in connection with power sites but that are well adapted for other uses will be recommended for restoration to entry with a reservation of the right of the government or its permittees to use them as power sites. Public lands that are found to be valuable as power sites and that are not already reserved will be classified as power-site land and withdrawn from entry.

### Detail of Program

The program for the 1923 field season includes:

Oregon—300 miles of Rogue River and tributaries will be mapped and surveys of dam sites will be made.

Northern California and Oregon—Survey of Klamath River from Keno, Ore., to its mouth, will be completed, involving 100 miles of additional surveys.

Utah—Surveys covering 100 miles will be made on the east or Yellowstone fork of Lake Creek, west fork of Lake Creek, Rock Creek, Duchesne River, and Uinta River.

Idaho—Surveys of a dam and reservoir site will be made on Salmon River.

Montana—A dam site on the south fork of Flathead River will be surveyed and a reconnaissance will be made to determine the possibilities of using the Missouri River and its tributaries above Great Falls, Mont., for power purposes.

Colorado—Surveys will be made on South Boulder River, Clear Creek, St. Vrain Creek, South St. Vrain Creek and Middle Boulder River, all tributaries of the South Platte River.

Wyoming—Surveys will be made in September on Sweetwater, North Platte and Encampment Rivers.

Arizona and Nevada—300 miles of Theola River will be mapped.

Washington—Investigations of the Columbia basin irrigation project are now being made.

## To Build Mouth-of-Mine Plant on Ohio River

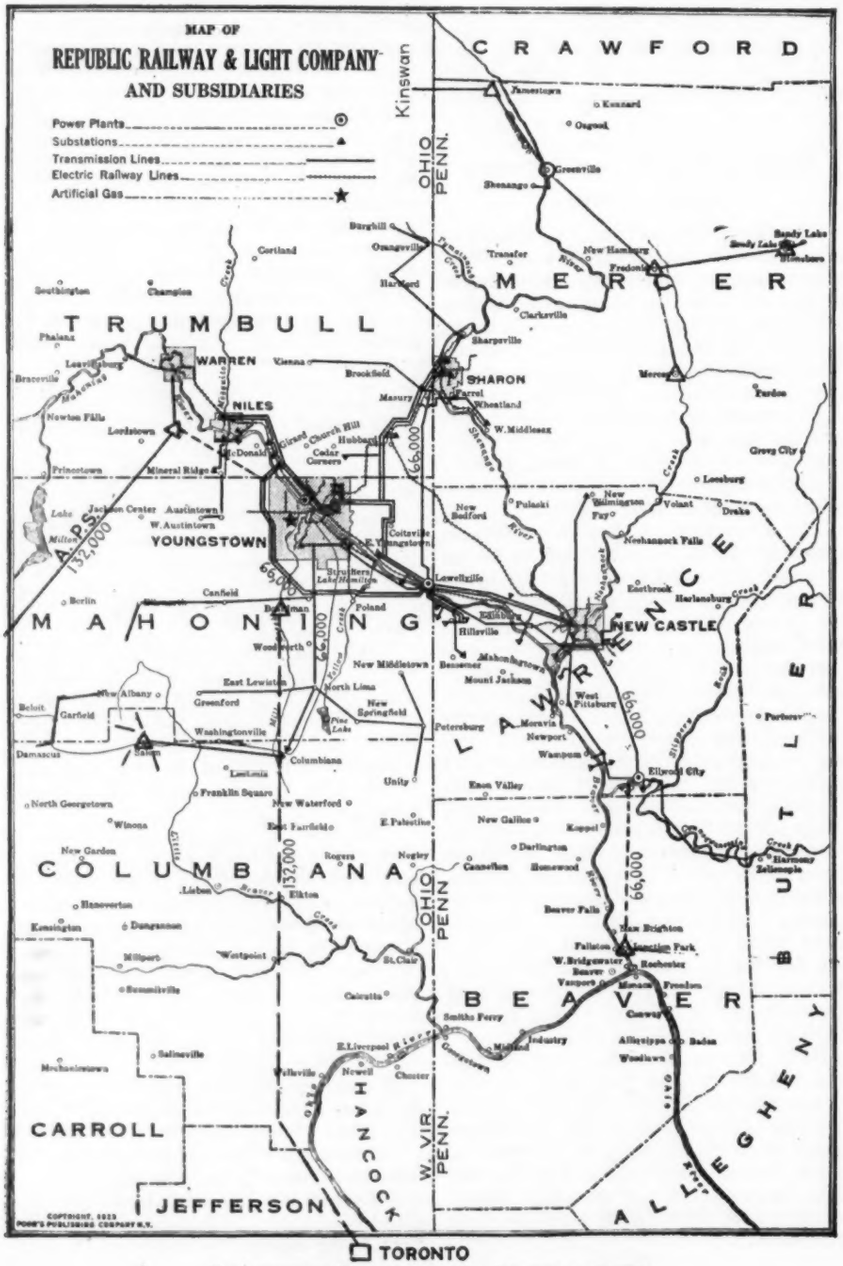
### Penn-Ohio Edison Company Plans Call for 240,000-Kw. Station to Use Pulverized Fuel

EXTENSIVE developments involving the construction of a mouth-of-mine power plant with an ultimate capacity of 240,000 kw. and the building of a 132,000-volt transmission line are being planned by the Republic Railway & Light Company through its recently organized subsidiary, the Penn-Ohio Edison Company. The latter company, by ownership of their common stocks, will control the following: Pennsylvania-Ohio Power & Light Company, Pennsylvania Electric Company, Ohio River Edison Company, the Salem Lighting Company and the Pittsburgh District Electric Company.

The Ohio River Edison Company will probably start construction within the next thirty to sixty days of a $10,000,000 steam plant using pulverized fuel on the Ohio River near Toronto, Ohio. The initial installation will consist of two 33,000-kva. units and the plans provide for future additions to the plant in generating units of the same size until the ultimate capacity is reached. The company controls about 7,000 acres of coal land immediately surrounding the site for the plant and development of this source of fuel is now under way. The plant when completed will be leased to the Pennsylvania-Ohio Power & Light Company for 999 years at an annual rental sufficient to show a substantial chance for dividends.

In addition to the proposed developments by the Ohio River Edison, controlled companies of the Penn-Ohio Edison Company now have an aggregate generating capacity of 105,540 hp., distributed by 315 miles of high tension transmission lines.

To transmit the power from the new station north to the Youngstown district a 132,000-volt line will be built which will be tied in with the 66,000-volt line of the Ohio Power Company near Wellsville. A 66,000-volt transmission line is also being constructed from Elwood City to Junction Park, Pa., at which point a tie-in will be effected with the transmission system of the Duquesne Light Company.




YOUNGSTOWN DISTRICT TO BE INTERCONNECTED

## Live Sales Problems Discussed at Association Island

The Sales Managers' Association held its twelfth annual convention on Monday, Tuesday and Wednesday at Association Island, Henderson Harbor, N. Y., with L. R. Wallis of Boston, the chairman, presiding. This body, having as its membership the sales managers and selected representatives of the larger central stations, holds its meetings behind closed doors. The following program was presented: "Back-Door Selling," by O. R. Hogue, Chicago; "How a Central-Station Can Keep Its Merchandising Department From Injuring the Independent Dealers," R. S. Hale, Boston; "Development of Electric Cooking and Heating Load," S. M. Kennedy, Los Angeles; "Recent Developments in Merchandising," A. Edkins, Chicago; "Merchandising and Accounting," D. R. Smith, Baltimore; "Illuminating Engineering and the Central Station," Julius Daniels, Boston; "Organized Sales Efforts," T. L. Phillips, Cincinnati; "Some Practical Notes on Domestic Refrigeration," N. T. Wilcox, Boston; "Some Service Suggestions," G. J. Liebman, Brooklyn; "Some Notes on Relations with Customers, with Special Reference to Bills," W. R. Boyd, New York; "Advertising," Ralph Neumuller, New York; "A.-C. Multiple Street Lighting Energy Supplied from Residence Secondary Mains an Undeveloped Source of Revenue," G. E. Miller, Cleveland; "Arrangements for Street Lighting in Suburban Towns," G. M. Mangan, Washington; "Electric Power in Building Construction," H. T. Luscomb, New York; "Results of an Electric Load Census," R. H. Tillman, Baltimore; "The Detroit Edison Company's Loop System of Alternating-Current Supply in the Downtown Area," J. D. Noyes, Detroit; "The Commercial Possibilities of the Non-Ferrous Electric Furnace," C. A. Barton, New York.

A special open session was held on Wednesday evening, which was addressed by M. H. Aylesworth, executive manager of the National Electric Light Association, who outlined in general terms the plans now forming for a nationwide survey of residence conditions by member central stations of the N.E.L.A. W. L. Goodwin of the Society for Electrical Development also spoke. An executive committee was elected for the coming year.

## Anthracite Report Stirs Up Diverse Comment

**National Emergency Clause Displeases Operators and Employees—Freight Rates to Be Investigated**

THE storm center of the anthracite report of the United States Coal Commission is the recommendation that the President be authorized to declare a national emergency, in case of a deadlock between operators and mine workers, and be empowered to take over the operation of mines and the distribution and marketing of the product. The operators fear that this would prove to be nationalization's entering wedge. Labor objects to it because there at least would be the coercion of public opinion brought to bear to make men work against their will. The public, however, seems to regard the measure with favor, not that it is anxious to see the government undertake any business activity, but because it believes the industry will avoid any invoking of the emergency powers and, with that alternative hanging over it, will reach an agreement.

The fact that the commission has indorsed, in effect, a combination of big business interests, under suitable regulation, throws into the congressional arena another highly controverted problem of our industrial life. It has been very popular in Congress for many years to lambaste any large business enterprise on the assumption that being big is *prima facie* evidence of its predatory character. Opinion, even in Congress, is changing to the point where the efficiencies of big business and the various benefits to the public of combinations are becoming apparent. It is true that the Coal Commission admits the possibilities of unjustifiable profits on the part of the anthracite combination, but on the whole its report shows that it was not afraid to commend it despite the fact that it is big.

Apparently the Interstate Commerce Commission is disposed to go to the full limit of its powers to assist in stabilizing the coal industry. This is indicated by the very prompt action it took in ordering an investigation of anthracite freight rates. The order was issued the day following the appearance of the report of the Coal Commission, in which such a recommendation was made.

There are some who believe that the decision in the assigned car case was expedited by the commission before the Coal Commission could have any opportunity to lay the responsibility at its door for the evils growing out of a practice which the commission had approved.

The carriers have made formal application to the commission for a rehearing in the assigned car case. This follows a meeting of railroad executives in Washington on July 10, at which meeting it was decided to take that action. If the commission does not believe a rehearing justified, it is asked to allow the carriers to present additional arguments. In case that request is not granted, the carriers then suggest that the commission give further attention to the situation of carriers purchasing for substantial periods the total output of mines and the situation of carriers owning their own mines and using the output thereof solely for railroad fuel.

## Transmission to Be Main Topic of Del Monte Convention

Four technical sessions have been provided in the provisional program issued for the Pacific Coast convention of the American Institute of Electrical Engineers, to be held at Del Monte, Cal., on Oct. 2-5. This program is as follows (Monday being devoted to registration and recreation):

WEDNESDAY, OCT. 3

*Morning*—Address, President F. B. Jewett; address, "Researches Relating to High-Tension Transmission," President-elect H. J. Ryan; symposium on construction of modern power lines: "Electrical Construction of Modern Power Transmission Lines and Insulators for High-Voltage Lines," H. R. Wakeman and H. W. Lines, Portland Railway, Light & Power Company; "Evolution of the High-Voltage Insulator," J. Koontz, Great Western Power Company; "Design of Anchor and Supporting Structures for the Carquinez Strait Crossing," L. J. Corbett, Pacific Gas & Electric Company; "Special Features of Design of Transmission Tower Lines as Imposed by Electrical Conditions," Walter Dreya, Pacific Gas & Electric Company; "Group Operation of Systems Having Different Frequencies" (two papers), E. R. Stauffacher, Southern California Edison Company, and R. R. Robley, Portland Railway, Light & Power Company; also papers by C. B. Carlson, Southern California Edison Company, and M. T. Crawford, Puget Sound Power & Light Company.

*Afternoon*—Symposium on waterwheel construction and operation: John Harrisberg (Puget Sound), E. D. Searing (Portland), E. W. Breed (Pelton Water Wheel), H. L. Doolittle (Southern California), and "A Study of Irregularity of Reaction in Francis Turbines," R. Wilkins (Pacific Gas & Electric); from papers on high-voltage switches, bushings and lightning arresters by D. W. Proebstel (Portland), M. Michener (Southern California), A. W. Copley (Westinghouse) and L. N. Robinson (Stone & Webster).

THURSDAY, OCT. 4

*Morning*—"High-Voltage Insulation," J. L. R. Hayden and C. P. Steinmetz, General Electric Company; "Power Resources of the United States" (illustrated), F. G. Baum; "Generating and Substation Machinery for Long Transmission Systems," W. Smith (Westinghouse); symposium on high-voltage transformers: "Performance of Auto-Transformers with Tertiaries Under Short-Circuit Conditions," J. Mini and R. Wilkins (Pacific Gas & Electric); A. W. Copley (Westinghouse), L. J. Moore (San Joaquin) and L. N. Robinson (Stone & Webster).

*Evening*—Presentation of Edison medal to Dr. R. A. Millikan, who will make an address.

FRIDAY, OCT. 5

*Morning*—Symposium on radio communication as applied to power transmission networks: J. Koontz (Great Western), E. A. Crellin (Pacific Gas & Electric), R. Ashbrook (Southern California); symposium on theory and practice in high-voltage operation: R. C. Wood (Southern California), W. D. Shaw (Southern California), A. W. Copley (Westinghouse); "Economics of Power-Factor Control of Long High-Voltage Transmission Lines," A. V. Joslin (Pacific Gas & Electric); "Methods of Voltage Control of Long Transmission Lines by the Use of Synchronous Condensers," J. Koontz (Great Western); papers on telephonic and radio communication by J. Koontz, E. A. Crellin and R. Ashbrook.

Sports, trips and entertainment will fill the time not devoted to technical sessions.

## Delay Versus Speed in Passing on Water-Power Projects

Some difference of opinion has arisen between the Chief of Engineers and the staff of the Federal Power Commission in regard to the degree of promptness which must be exercised in answering declarations of intention to make use of the power resources of a stream. The Power Commission's staff interprets the requirement of the act that an investigation be made and a finding reached without delay to mean that a special effort must be made at once to report on the proposed project. It is recalled that in the debate on the water-power bill the fear was expressed that federal red tape would entail long delays before any development could proceed. So that it may not be open to that criticism, the staff of the Power Commission has been particularly careful to decide quickly as to whether or not it has jurisdiction.

Two months ago the Power Commission received a declaration of intention from C. Boice, covering a power site on the Pigeon River in North Carolina. This stream is a tributary of the Tennessee. A report from the Chief of Engineers is required to determine whether or not the Federal Power Commission has jurisdiction. That official, however, has stated that it will be impossible to make this report until that stream can be reached in the orderly completion of the survey of the upper Tennessee which is now in progress. This does not please the declarant, who is anxious to proceed.

Incidentally, any delay in acting on the declaration of intention is thought to be highly pleasing to the Tennessee River Improvement Association and others who are particularly interested in Muscle Shoals. Apparently they fear that the location of industries on the upper tributaries of the Tennessee will take from Muscle Shoals what otherwise might have been located there. In this particular case it is believed that the Federal Power Commission will decline to take jurisdiction.

## Rural Telephone Users in Oklahoma to Be Educated

A statewide program designed to improve the service from the rural telephone lines will be undertaken in Oklahoma by the Southwestern Bell Telephone Company, and the Oklahoma Utilities Association will carry on a similar campaign among the rural companies not reached by the Bell company. The method of approach is to invite all patrons of a group of rural telephone lines to a conference and to show by lectures and demonstrations the greater efficiency and better service afforded by properly constructed facilities. It is proposed to place ordinary telephone supplies with dealers in small towns in order that ordinary repairs can be made without delay. The meetings will be attended and addressed by competent men.

## Merger in New York

**Niagara Power to Supply Towns in Cohocton Valley — Extensions Planned in Other Territory**

THE New York Central Electric Corporation, incorporated last December, has filed papers with the Public Service Commission asking for authority to merge the Warsaw Light & Power Corporation, the Perry Light & Power Corporation, the Hornell Electric Company, the Yates Electric Light & Power Corporation of Penn Yan and the Wayne Power Company, which supplied power to all the towns of the Cohocton Valley north of Kanona.

These same interests now are operating all the companies and recently acquired the plant at Dansville, and have approached Hammondsport. Bath is considering the sale of its electric plant to the same company.

The New York Central Power Corporation now holds a contract with the Lockport, Niagara & Ontario Power Company, which provides for the delivery of power to the New York Central Corporation at Niagara. Supply lines already have been constructed from Warsaw to Perry and now are under construction from Perry to Hornell.

George W. Olmstead of Ludlow, Pa., is president of the New York Central Electric Corporation, and E. L. Phillips of New York, formerly of Prattsburg, is vice-president.

In the interests of the corporation franchises for the extension of the lines have been granted by the towns of Bradford, Wayne, Bath, Pulteney, Wheeler, Prattsburg and Thurston in Steuben County, Orange in Schuyler County, Barrington, Benton, Milo and Tory and the village of Dresden in Yates County.

With the extension of the Niagara lines into the New York Central Electric Corporation's territory, the Lamoka Power Corporation and the Lamoka Electric Water Power Corporation of Corning are assured of a practical market for their power.

The Lamoka company was reorganized recently and William H. Foxall of Rochester was made president and Dr. George F. Showers of Corning was chosen secretary and treasurer.

In the interests of the Lamoka Power Corporation 2,600 acres of property in the Mud Creek Valley have been taken over, as have also the Kanona Roller Mills and the water rights of the Savona Roller Mills.

## Electragists Meet in Denver

James R. Strong of New York City, president of the International Association of Electragists, and Laurence W. Davis of the Empire city, director of promotion and development for the association, were the principal speakers before the convention of the Mountain States division of the International Association of Electragists' meeting, held in Denver, July 16. The Mountain States division comprises the states of Colorado, Wyoming, New Mexico, Utah, Montana and Idaho. About 100 delegates attended. President Strong, after explaining just what the association has done and is planning to do, said:

"The benefits to be desired from an association are directly proportionate to the amount of study given by the members to the educational data. Be first an electragist and then give at least five hours a week to the study of your particular business and to the educational data furnished." Mr. Davis spoke on "Estimating and Selling the Job."

A. P. Peterson, Western field representative from Minneapolis, spoke on the subject "Residence Wiring Survey" and showed where one job submitted to eighteen contractors brought in bids ranging from $60 to $187. It was proved that the actual cost was $93.50, and he then urged the necessity of understanding estimates and showed how to compute them. He will remain in Denver for an indefinite period to develop the work of the association.

## Wisconsin Utilities Prosperous

Due to the ever-increasing demand for gas, electric, telephone and street railway services, the public utilities of Wisconsin show a tremendous growth in the amount of money invested in the business, in the total revenues received and in the number of customers served, according to the latest report of the railroad commission, which does not include the figures for 1922.

Electric light and power companies, however, show the greatest growth of all utilities in Wisconsin in investments as well as in revenues and number of customers. Although the revenues increased to a considerable extent between 1917 and 1920, the operating expenses increased even more rapidly, and the amount available for return upon the investment decreased from 5.62 per cent to 5.48 per cent. The increased cost of operating the electric utilities made it necessary to increase the rates in many instances, and this increase in rates is reflected in the increased revenues for the year 1921. This fact, together with a decline in prices, increased the rate of return to 6.99 per cent for the year 1921.

"The total amount of capital invested in all electric utilities in Wisconsin in 1921 was $116,564,856," says the commission's report. "This is an increase of $12,064,488, or 11.5 per cent, over the property value of 1920, and $44,528,616, or 61.8 per cent, over that in 1917.

The rate of return on the money invested in all these properties for 1921 was 6.99 per cent. Electric consumers in 1921 were 285,209, an increase of more than 15 per cent over 1920. Street railways carried in 1920 287,905,241 passengers and in 1921 265,392,587, a decrease of 7.8 per cent. Telephone subscribers increased from 401,338 in 1920 to 414,345 in 1921. Gas consumers increased from 214,294 in 1920 to 219,320 in 1921.

## Cooper Plan Outlined

**St. Lawrence Development Plans Propose the Immediate Installation of 1,200,000 Hp.**

THE development of the St. Lawrence River is exciting a great deal of interest in the electrical industry. Several corporations have plans outlined and one of the most active is that of the Frontier Corporation, which is backed by the Du Pont Company, the General Electric Company and the Aluminum Company of America. Colonel Hugh L. Cooper, consulting engineer for the corporation, filed the plans of development of that corporation with the International Joint Commission, which reported to the United States and Canada on the development.

At present the 120-mile stretch between Ogdensburg and Montreal, with a drop of 220 ft., transports 4,500,000 tons of freight a year and develops 200,000 hp. The International Joint Commission report, based on recommendations of government engineers, proposed three dams, nine locks, 31 miles of canals and the installation of 4,545,000 hp. capacity, at a total cost of $506,000,000 without interest during construction.

Colonel Cooper's plans call for five dams, six locks, 6 miles of canals and 5,400,000 hp. capacity, at a total cost, including all charges, of from $1,250,000,000 to $1,400,000,000. Of this development 4,200,000 hp. would go to Canada by treaty right, but it is considered probable that part of this power could be used in the United States until Canadian markets require it. An annual movement of over 100,000,000 tons of freight is forecast should the project be completed.

As the first step in this program, Colonel Cooper proposes the installation of a 1,200,000-hp. unit at Cat Island, about midway between Morrisburg and Cornwall.

The Frontier Corporation now owns in fee Cat Island and about 4,200 lineal feet of New York shore line opposite to and above the island.

These interests are prepared to furnish all funds for the construction at that point of a control dam 2,750 ft. long and two power houses each 3,100 ft. long, with their hydraulic and electrical contents, up to and including the low tension bus bars, at an estimated cost of $200,000,000. At the same time, Colonel Copper points out that the cost of this first unit will be so great that the concerns behind the Frontier Corporation can never be more than leaders and minority holders of the necessary securities.

All navigation facilities would be paid for, owned, operated and maintained by the two governments. Interests behind Colonel Cooper would act as construction agents for a fixed fee equal to 6 per cent of the adopted cost estimate. Cost of a 30-ft. channel at the site is estimated at $30,000,000. All structures connecting upstream ends of the power

houses with navigation facilities and the shores would be paid for, owned and maintained by the two governments.

The principal opposition to the plan thus far has come from the Great Lakes-St. Lawrence Tidewater Association, which fears navigation may be subordinated to power, and also from New York and New England.

## Proposes Farm Power at $5 per Hp.-Yr.

### Report of American Farm Bureau Federation Outlines Power Development Policy—Backs Ford

THE annual report on American Farm Bureau Federation legislation activities, presented by Gray Silver, Washington representative to the executive committee, has just been issued and widely distributed in pamphlet form. Among other subjects it deals voluminously with power and its relation to farmers. The following extracts of the report will be read with interest by the electrical industry:

We have made a start in the direction of legislation affecting the lowering of farm costs in what we buy. But that is a field that remains largely with the future. The first part of it is to establish through the adoption of the Henry Ford Muscle Shoals plan the principle of amortization of capital costs in hydro-electric power development.

#### Electric Power Cost Mostly Interest

We are told on the highest technical authority that in the case of a certain so-called "cheap electric power production," which costs $24.42 annually, no less than $18.90 goes to pay for interest on the investment. The average investment per horsepower in hydro-electric plants is $300. And east of the Rocky Mountains the average annual cost per horsepower is about $30 a year, of which, roughly, $24 goes up in the smoke of interest. That is, about 80 per cent of the cost of generating hydro-electric power goes now and, under the present system, tends to go on forever to pay interest on the first cost of the plants. For while it is true that these plants are now financed on the old basis, they do, however, carry a charge against the business equal to an amortization charge to retire the capital securities. As this is now usually done, at the end of the amortization period instead of signalling reduced rates it is too often an occasion for further "financing" or "melon-cutting" that will keep the interest fires burning. It is not in human nature for the interests that own and build great power plants to apply income to retiring their principal when they can keep it forever at interest. The new way means that we will eventually get power for $5 or $6 per horsepower per year instead of $25 or $30, that interest will not run on forever, and that during the pay-off period interest will be 4 per cent instead of 8 per cent, which represents the difference between public and private credits.

#### Cheap Power and the Fertilizer Problem

Cheap power is of tremendous interest to farmers in more ways than are apparent at present. Perhaps the most important meaning of cheap power on the farm at present is cheap fertilizer. We are coming into an age when artificial fertilizer must be universally used if the production and value of our farms are to be maintained.

We must look for the solution of this pressing problem in the fixation of nitrogen from the air and in the cheap production of other fertilizing elements by the use of the electric furnace.

Muscle Shoals is only a step—the first step—in the solution of the great power problem, but it is supremely important because if we succeed in our advocacy of the Ford tender we shall have established a ruling precedent for the future utilization of water power development on the plan of paying off and then charging off forever the original improvement costs with no chance of their continuation through melon-cutting stock dividends, improvement bonds, etc. If we fail here interest will grip and hold indefinitely all of the great water powers the government still controls and our children's children will be paying interest on capital investment on every stream in the land long after such investments have in equity been paid off.

This principle is now asked in the development of the Colorado River with 5,000,000 potential housepower, in the huge Columbia River Basin irrigation project, and, in fact, altogether may eventually reach to perhaps 50,000,000 water horsepower without the building of storage works and 200,000,000 hp. with a universal system of storage. To wipe out interest charges on 50,000,000 hp. means at least $1,000,000,000 of annual savings in interest charges along and of $4,000,000,000 on the potential power development of America. Moreover, as original costs are always pyramided, that is, included in interest and profit computations again and again in each step on the way from the producer to the consumer, the wiping out of an interest charge of $1,000,000,000 means perhaps as much more by the time the bill gets to the consumer for the commodities made by the power. Electricity is the ideal power. There are almost no limits to which electric power can ultimately be transmitted. Farmers residing hundreds of miles from hydro-electric power plants will have their power in that form.

#### Higher and Happier Farm Life

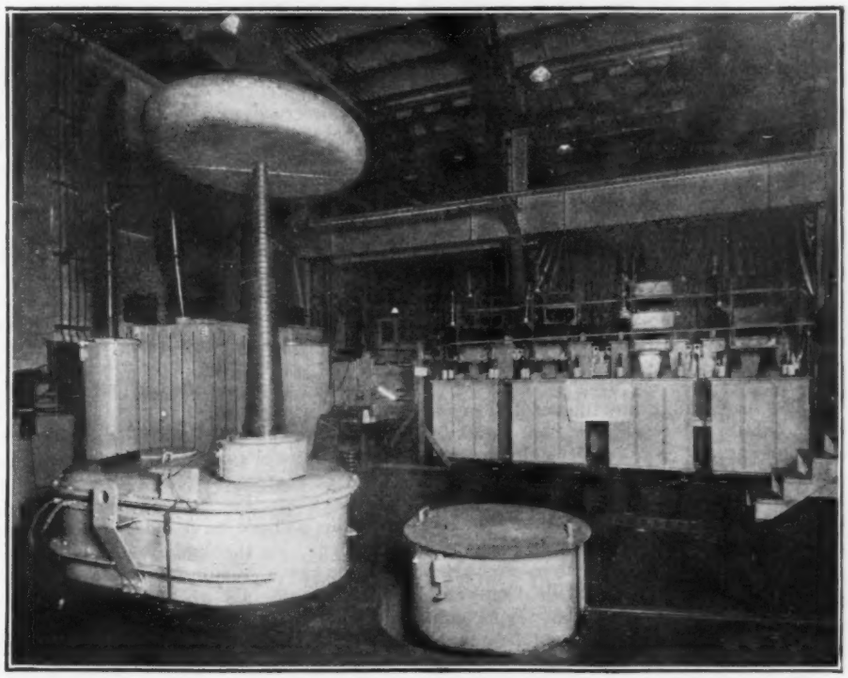
The mechanical application of power in modern civilization puts mechanical genii to work for us. Today there are thirty such helpers working for the average American, but the farmer is far from having his share of them. Electricity at $10 or less per horsepower per year will carry the water from the spring or well to the home and to the barn; will milk the cows; will wash the clothes and iron them; will sweep the house; will do away with the necessity of filling, trimming and washing kerosene lamps; will replace the boy at the woodpile; will substitute the electric cook stove with its automatic control for the wood or coal stove and thereby remove the necessity for frequent sweeping and scrubbing to remove wood and coal soil from the floors. Cooking, washing, ironing over superheated cook stoves will then be of the past, for the electric cook stove with its insulation will control the heat so the kitchen will be almost as cool as any room in the home. The electric refrigerator will come to the farm home and provide not only storage but also abundant ice ready for use. It will be found also in the farm dairy. Moreover, electricity will grind feed, shell corn, run the cream separator and the churn, cool and heat the house, and in fact, permit the use of labor saving devices and comfort making equipment which will eliminate most of the drudgery of farm home life.

Once the principle of wiping out the dead burden of unnecessary perpetual interest charges is established it may be applied in other processes than in the development of hydro-electric power. The steam electric power of the future will be developed at the coal mines and we will haul weightless electricity on wire cables instead of heavy and bulky coal in lumbering gondolas on costly railroads, thereby greatly reducing railroad rates. Such power will take care of the regions that have not enough water power to meet their needs. There are still immense areas of coal land and oil fields in the public domain. The principle of amortization can and will be applied to these central power stations.

The development of cheap electric power on a huge scale portends the electrification of the railways, which indeed is one of the inevitable solutions by which the present baffling problem of railway congestion, excessive transportation costs, and inefficiency is to be overcome. Electricity means more efficient service—and more economical. That spells cheaper transportation rates. Hydro-electric power, on this basis, used on a railway locomotive is equivalent to using coal at 92 cents a ton instead of $3 to $3.25.

The above extracts are only part of the voluminous treatment of power and power legislation.

## Lightning Arrester Test Set



WITH this test set, installed at the plant of the Westinghouse Electric & Manufacturing Company, it is claimed that a 240,000-volt discharge with an instantaneous power maximum of very nearly 3,000,000 kva. can be obtained.

It is being used chiefly to test the relative merits of different types of lightning arresters. The apparatus consists of eight condensers having a total capacity of 0.1 microfarad charged through electron tubes to 240,000 volts by the transformer at the left. In one test which was made shunting a 15,000-volt pin-type insulator with a sphere gap in series with a resistance of 1,000 ohms the resistance proved too high to prevent insulator flashover, whereas a 15,000-volt "autovalve" arrester under the same conditions did protect the insulator.

## No Market for Alaska Water Power

**Applicants for Water-Power Licenses Losing Interest—Many Small Sites Available**

DURING the President's stay in Alaska sight seems to have been lost of the fact that economic conditions have a bearing on water-power development. Some of the Alaskans seem to be of the opinion that most of the water power in the territory would be developed immediately were the Federal government to withdraw its restrictions. But an analysis of the Alaskan applications indicates that there are economic reasons why these developments have not gone forward. Coupled with this has been an apparent misconception on the part of the local interests as to their responsibilities in connection with these applications. In many instances applicants lost interest when they ascertained that expense is entailed in complying with the conditions of preliminary permits. Excluding the licenses, covering half a dozen small plants, which were in existence prior to the enactment of the water-power law, only one license for a major project has been granted out of the entire number. Fifteen preliminary permits have been granted, but there are only two which show promise of going through.

A careful reconnaissance has shown that there are twenty power sites in southeastern Alaska where power is available for pulp mills of sufficient size to make possible their operation on the most economical scale. So far as compliance with the Federal water-power act is concerned, there would be little difficulty in securing rights for these developments. The information which has reached the Federal Power Commission, however, is to the effect that economic conditions are not favorable at this time to the development of the pulp industry in Alaska.

## New Development Committee N.F.P.A. Holds First Meeting

The first public meeting of the newly appointed sub-committee on new developments of the electrical committee of the National Fire Protection Association was held at 123 William Street, New York City, on July 17. The committee presented for discussion a new Underfloor duct system, manufactured by the Johns-Manville Company, and a new twin-conductor wiring material known as Romex, manufactured by the Rome Wire Company.

The morning was devoted to a hearing on the new underfloor duct system, which consists of a semi-circular fiber duct with suitable junction boxes and other fittings imbedded in concrete floors of fireproof buildings. The afternoon was devoted to a hearing on the Romex cable, which is a twin conductor consisting of rubber-covered wires with special non-metallic protective coverings intended for use in wiring circuits in both open and concealed work without metal armor, conduit or flexible tubing. Strenuous objection was voiced to both these products on the score that they would tend to break down the high standard of the code and increase the electrical fire hazard.

A very strong appeal was made in behalf of Romex cable by Ernest McCleary of Detroit, representing the contractor's viewpoint, stressing the great need for more economical material for the wiring of small buildings. A representative of the farm-lighting industry described the great benefits which will follow the establishment of some approved method for wiring the farm home more quickly and more cheaply.

At a meeting of the committee on new developments, held on July 18, it was voted that the committee should notify the submitters of the Underfloor and Romex materials and the electrical industry as represented at the public hearings that the committee extends the period within which briefs on these products may be filed to Oct. 1, 1923, and that it is the expectation of the committee that action will be taken on these subjects at a meeting to be held as soon after the above-mentioned date as possible.

The committee requests that briefs submitted be sent with twelve copies, one for each committee member.

## St. Louis Utility Properties Consolidated

The Missouri Public Service Commission has granted the Union Electric Light & Power Company of St. Louis, a subsidiary of the North American Company, permission to purchase the Missouri properties of the Light & Development Company. The purchase price of the St. Louis properties of the latter was given at approximately $9,000,000, but only about $5,000,000 will actually change hands, the Union Electric company assuming about $4,000,000 indebtedness of the Light & Development Company. The commission directed that the Union company keep separate accounts in each of the several towns where the utilities will be maintained, and that it add only so much of the purchase price to its capital stock as the commission shall later find is a fair value of the property.

These properties are chiefly light and power plants in the territories served by the Union Light & Power Company in and around St. Louis, the two companies having competed in some localities.

The purpose of this merger, it is said by officials of the North American Company, is to remove competitive situations and improve service. Economies in operations are also expected to result from the consolidation and better and more reliable service.

# Federal Views on the New York Water Power Report

**No Concessions Granted by Federal Commission—State Suit Should Be Pressed or Withdrawn—No New Interpretation of the Water-Power Act**

FEDERAL officials are not inclined to concur in the recommendation of the New York State conferees that the suit in the United States Supreme Court against the Federal Power Commission should not be pressed for the present. The Federal officials who are familiar with the situation contend that the state should either press the suit or withdraw it.

The report on behalf of the New York Water Power Commission makes frequent reference to concessions on the part of the Federal Power Commission. There have been no changes whatever in the policy of the commission as a result of the conference with the officials of the state of New York.

Particular exception is taken to the statement in the report that "if the state is not able to obtain from its own Legislature a grant of favorable legislation, it makes little difference whether it is the Federal commission or the state commission which licenses the state's power to private interests, as in either case the water power of the state will be out of the hands of the people of New York, who really own it." The outstanding feature of the Federal water power act is that the public retains its possession of the resource and simply leases it under certain specified conditions to those who undertake its development.

The report as a whole is regarded as an effort to retire gracefully from an untenable position.

## Ford Uses Auxiliary Steam Plant at High Dam

The Ford license covering the High Dam development at St. Paul has been amended so as to include the use of additional government land sufficient in extent to furnish a site for the auxiliary steam plant, the terminals of the tunnels and other connections between the power house and the factory. The auxiliary steam plant is to be erected immediately adjacent to the hydro plant. It may be simply an extension of the same building.

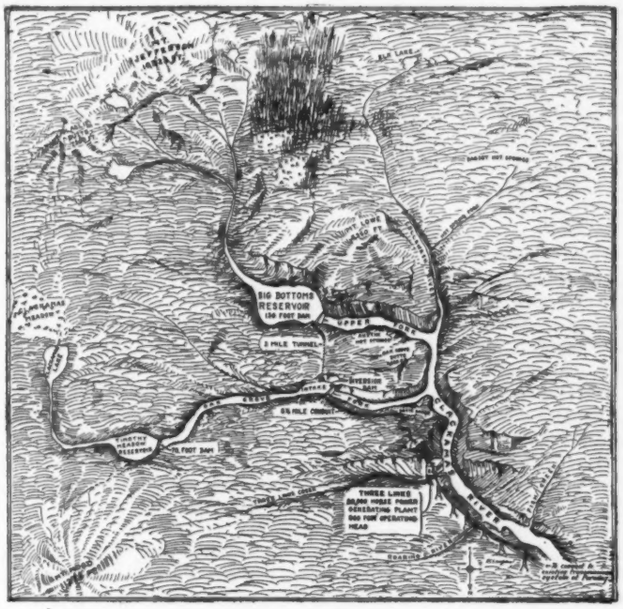
Col. L. H. Brittin, who went to Washington to negotiate the amendment to the license, reports rapid progress on the part of Stone & Webster, who are in charge of the construction work.

## Hydro Development on the Clackamas River

**Portland Railway, Light & Power Plans 105,000-Hp. Plant to Cost $15,000,000**

THE Portland Railway, Light & Power Company is proceeding with the construction of a gigantic hydro-electric development, which involves the expenditure of $15,000,000, approximately 60 miles southeast of Portland in the region of the headwaters of the Clackamas River and its tributaries. The complete project, which is to be built in three units, involves the drainage of 318 square miles of forest lands in the heart of the Cascade Mountains, which have been leased for a period of fifty years from the government, as they lie in a forest reserve.

The complete plant will develop a total of 105,000 hp. and will be constructed in units of 35,000 hp. each and will supplement the other plants of the company, among which are the plant at Faraday, which produces 20,000 hp., and the one at River Mill, developing 16,000 hp. Both of these plants are located on the Clackamas River and about 20 miles nearer Portland than the new installation and derive their water supply from that stream.




COMPLETE UTILIZATION OF 318-SQUARE-MILE DRAINAGE AREA

The first unit of the present project involves the construction of a diversion dam on the Oak Grove Fork of the upper Clackamas River, 29 miles above the site of the present plant at Faraday. There is available at the new site 430 sec.-ft. of unregulated flow at an elevation of 2,035 ft. From the intake at this dam the water is to be conducted through a steel conduit a distance of 6 miles to the summit of Cripple Creek Knoll, which is 1,850 ft. above sea level. From this knoll penstocks will extend 900 ft. down the face of the cliff to the turbines in the power house on Three Links Creek.

The steel plate for the conduit was produced by the Bethlehem Steel Company at Sparrow Point, Md., and was transported by water to Portland, where it has provided work for 500 men for six months in the shops of the Willamette Iron & Steel Company in forming it into pipe. Ninety-five hundred tons of steel was required, of a thickness of from $\frac{3}{8}$ to $\frac{1}{2}$ in., for the pipe, which is in sections of 40 ft. in length and 9 ft. in diameter. These sections are now being transported in wooden cradles on flat cars to the location of the line.

A 400-ft. right of way is being cleared for the pipe and transmission lines to protect them from falling trees and a trench is dug by steam shovels for the pipe, trestles being used to carry it across ravines.

The pipe line is terminated in a 360-ft. tunnel which pierces Cripple Creek Knoll with a fall of 48 ft. and ends at the penstock above Three Links Creek. A surge tank will rise from the roof of the tunnel, 20 ft. above the knoll and 5 ft. above the top of the dam at the intake, 6 miles away. The penstocks have a slope of 35 deg. and a length of 900 ft. The steel pipe is 8 ft. in diameter at the top and 6 ft. at the bottom.

From the power plant the energy will be transmitted at high voltage a distance of about 20 miles to Faraday, where it will connect to the existing high-tension lines. Seventy-three-foot steel towers will support the lines, which cross the river eighteen times during the distance.

Construction of the second unit involves the building of a 3-mile tunnel to connect the upper fork of the Clackamas at Big Bottoms with the intake reservoir on Oak Grove Creek. This will make necessary a second pipe line from the intake to the Three Links plant.

The third unit contemplates the building of a storage reservoir of 1,139 acres surface area at Timothy Meadows on Oak Grove Fork and one of 992 acres area at Big Bottoms.

Seventeen construction camps have been required on the first unit, which employs some 1,700 men, who occupy tent houses with board walls and floors. Ninety-one thousand meals are served monthly, consuming 217 tons of foodstuffs in that period. It is expected that operation of the new plant will begin by July, 1924.

## Hydro Plant for Northeastern Pennsylvania

Interests associated with the Pennsylvania Power & Light Company have bought the Pennsylvania, New York & New Jersey Power Company and plans are now being made for the immediate development of the power site formerly owned by that company on Wallenpaupack Creek, located in the northeastern part of the State of Pennsylvania, near Hawley.

The plans contemplate the building of a hydro-electric development to have an installed generating capacity of 40,000 kw. The work in connection with this development will include a concrete dam 1,150 ft. long with a maximum height of 50 ft. above the riverbed. This dam is expected to create a reservoir about 12 miles in length covering an area of 5,600 acres.

Water will be conducted through a 14-ft. pipe line, about 3¼ miles long, to a surge tank and thence by two 8-ft steel penstocks, each 750 ft. long, to the power house, which is to be situated on the south shore of the Lackawaxen River.

Electric energy will be fed 50 miles to the south into the Pennsylvania Power & Light Company's present system over several transmission lines, one of which is to be a 220,000-volt steel tower line.

It is estimated that the final cost of the complete development, together with the transmission lines that are to be constructed, will be approximately $8,000,000. Construction work, which will take about two years to complete, will be begun as soon as possible in order that water may be impounded in the reservoir next spring.

In connection with this work there have also been purchased by the same interests the Wayne Development Company and the electric companies operating in Honesdale and Hawley. During the last several months companies have been organized by Pennsylvania Power & Light Company interests in various townships between the Wallenpaupack power site and the present system of the Pennsylvania Power & Light Company so that transmission lines can be built and this additional territory served with electric power and light. It is contemplated that all of these companies, including those involved in the Wallenpaupack development, will in due course be absorbed.

This latter company and associated companies now operate in an extensive territory in eastern Pennsylvania and furnish electric power and light service in more than 140 communities, including the Allentown-Bethlehem industrial section, the anthracite coal district in and around Wilkes-Barre, Hazleton, Shenandoah, Shamokin and Mount Carmel, and the industrial and agricultural section along the Susquehanna River around Milton, Danville, Bloomsburg, Berwick, Sunbury and Williamsport.

# Brief News Notes

**English Road Electrifies.**—The Southeastern Railway has accepted the offer of the Metropolitan Vickers Electrical Company to build 508 electric motors and control gear. It is the intention of the company to electrify its road within a radius of 15 miles in the suburban sections. The contract is probably the largest main line electrification ever placed in England.

**Activity in Iowa.**—The Iowa Electric Company of Cedar Rapids has purchased the plant of the Cascade Electric Light & Power Company and will supply the city of Cascade over a line from Monticello. The Iowa Service Company has received permission to construct a $40,000 line from Red Oak to Villisca and the Southern Iowa Electric Company has been granted a franchise to serve Williamson.

**St. Joseph Valley, Indiana, Booming.**—With plans for the construction of a $16,000,000 electric power plant in the St. Joseph River valley near South Bend has come the announcement of plans for a large paper mill on a site near the power plant. The paper mill will be constructed by the Lasalle Paper Company and will cost $250,000. It is hailed as the first step in a St. Joseph Valley industrial boom which is expected to follow the establishment of the new power plant.

**Progress of Houston Company.**—The Houston (Tex.) Lighting & Power Company, which has, according to a report filed with the Public Service Commission, spent $2,632,000 on the first four-million-dollar unit of its new plant, besides nearly $2,000,000 for substations and improvements, expects that during the present year the company will be called upon to serve 200,000 customers, an increase of 5,000. The increased load in horsepower expected during the year is 10,000, which would bring the total to 121,260.

**Westinghouse Scholarship Winners Announced.**—The winners of the four Westinghouse War Memorial Scholarships for 1923 have been announced. They are: George Earl Doty of Pittsburgh, who will study electrical engineering at Carnegie Institute of Technology; Lawrence B. Biebel of Oakmont, Pa., who will take a course in electrical engineering at the University of Pittsburgh; Paul M. Williams of Wilkinsburgh, Pa., who will study electrical engineering at Carnegie Institute of Technology, and Lee P. Doyle of San Francisco, who will go to Ohio State University for a course in electrical engineering.

**Alabama Power Takes Over Greenville Properties.**—An agreement has been reached whereby the Alabama Power Company will take over the properties of the Greenville Electric Manufacturing Corporation of Greenville, Ala., provided permission is given by the Alabama Public Service Commission. President Thomas W. Martin of the Alabama Power Company was in Greenville recently, where he addressed a large delegation of business men from Greenville, Bolling, Foresthome, McKenzie, Georgiana, Luverne and other places. The cities are anxious for enlarged hydro-electric facilities and it is practically certain that the state utility board will grant the petition for the entrance of the Alabama Power Company.

**San Francisco Body Opposes Retailing of Hetch-Hetchy Power.**—The San Francisco Bureau of Governmental Research is opposing a plan for the city to acquire and dispose at retail of available power from the Hetch-Hetchy development, on the ground of insufficient city funds to make distribution pay. Interest and redemption charges, the bureau says, will total $2,800,000 for the next fiscal year and increase as idle bond funds available for reinvestment decrease. It also points out that the city is within $9,000,000 of its debt limit under official interpretation and its engineers estimate it will require $12,400,000 to carry the proposed Hetch-Hetchy program up to Dec. 31, 1924.

**International Radio Rules.**—For the purpose of considering the necessity of an international wireless convention, a meeting of telegraphic experts representing the British, French and Italian governments was held July 18 at the London office of the League of Nations. The experts agreed on the drafting of international regulations with regard to wireless communications and the proposed convening of an international wireless and telegraphic conference at the beginning of next year. Negotiations to this effect are already in progress between certain governments, and if these are not successful before Oct. 1 the experts again will meet to support the proposal emanating from the Italian government for calling such a conference under the League of Nations.

**Hydro-Electric Investigation on Cumberland.**—Extensive development of hydro-electric power on the Cumberland River by the Federal government in connection with its present program of rendering the stream more navigable may be the outcome of an investigation into the advisability of constructing three large power-navigation dams between Carthage and Burnside, Ky., to be started by Major Harold C. Fiske, United States district engineer. Orders to suspend operations on ten proposed sets of locks and dams between Lock No. 8, near Carthage, and Lock No. 21, at Burnside, pending a full investigation of the amount and market for hydro-electric power that can be developed on the Cumberland River in this area, were received and a conference was held with interested parties on July 23. The length of the river between Burnside and Carthage is approximately 170 miles and contains a fall of 114 ft.

# Associations and Societies

**Rural Electrification to Be Discussed by Agricultural Engineers.**—The seventeenth annual meeting of the American Society of Agricultural Engineers will be held in Chicago on Nov. 8, 9 and 10. Among other things on the program, a special rural electrification session will be held on Friday, Nov. 9. It is expected that men from the central-station and agricultural fields will be heard at this session.

**Special Lighting for I.E.S. Convention.**—Detailed plans for the special features which will mark the 1923 convention of the Illuminating Engineering Society to be held at Lake George, N. Y., Sept. 24 to 28, are nearing completion. A battery of great searchlights forming a scintillator of moving colored beams will be located on the wharf in front of the Fort William Henry Hotel, convention headquarters. An elaborate program of fireworks is another feature, a high point of which will be the explosion of the largest bomb used in such displays. A jeweled emblem of the society, illuminated in various colors by floodlights, is another thing of interest on which the committee is working. The officers of the convention committee consist of Mr. Ryan as chairman, Henry W. Peck, vice-chairman, and H. E. Mahan, secretary. Announcement is expected to be made shortly on the program of business sessions and entertainments for the ladies.

### Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 7 issue, page 56, for latest list.]

National Electrical Credit Association—Boston, Aug. 9-10. F. P. Vose, 1347 Marquette Bldg., Chicago.

New England Division, N. E. L. A.—Swampscott, Mass., Sept. 5-8. Miss O. A. Bursiel, 149 Tremont St., Boston.

Conference of Electrical Leagues.—Association Island, Sept. 16-19. Society for Electrical Development, 522 Fifth Ave., New York.

Rocky Mountain Division, N. E. L. A.—Glenwood Springs, Col., Sept. 17-19. O. A. Weller, 900 15th St., Denver.

Association of Edison Illuminating Companies—Dixville Notch, N. H., Sept. 17-21. P. S. Millar, 84th St. and East End Ave., New York.

Michigan Electric Light Association—Grand Rapids, Sept. 18-20. Herbert Silvester, Detroit Edison Co., Ann Arbor.

Illuminating Engineering Society—Lake George, N. Y., Sept. 24-28. S. G. Hibben, 29 West 39th St., New York.

Association of Iron and Steel Electrical Engineers—Buffalo, Sept. 24-28. J. F. Kelly, 513 Empire Bldg., Pittsburgh.

Indiana Electric Light Association—French Lick Springs, Sept. 26-29. T. Donahue, Northern Indiana Gas & Electric Co., Lafayette, Ind.

American Electrochemical Society—Dayton, Ohio, Sept. 27-29. Colin G. Fink, Columbia University, New York.

American Institute of Electrical Engineers—Pacific Coast convention, Del Monte, Cal., Oct. 2-5. F. L. Hutchinson, 33 West 39th St., New York.

Association of Electragists International—Washington, Oct. 8-13. Farquson Johnson, 15 West 37th St., New York.

# Commission Rulings

**Amortization of Abandoned Property.**—A sufficient amount was allowed by the Indiana Public Service Commission in fixing the operating requirements of the Martinsville Gas & Electric Company to cover long-time amortization of property rendered useless. The commission held that if any portion of the present standby property was not used and useful, it should be eliminated from the rate base, but the stockholders should not be arbitrarily deprived of any part of their equity.

**Discontinuance of Free Service as Part Payment for Right-of-Way Approved.**—One John L. Grimes complained to the Pennsylvania Public Service Commission that a contract provision for free gas as part of the consideration for a right-of-way had been disregarded by the Manufacturers' Light & Heat Company. This action by the company the commission found to be right, as under the Pennsylvania commission law free service was unlawful. The commission had no jurisdiction over the question of the right of the company to continue to occupy the right-of-way in question.

**Obsolete Character of Equipment Reflected in Fixing Rates.**—Finding a complaint against the Peekskill Lighting & Railroad Company justified as to the rates charged by it for gas but not as to the rates charged for electricity, the New York Public Service Commission had these observations to make on the condition of the plant and the necessity for amortizing depreciation as related to the fixing of a proper return: "The property may be 100 per cent efficient for operating purposes, but not be at anything like 100 per cent as representing what the securities outstanding were put out for or what the properties as shown by the balance sheet have cost the investors. The various buildings and apparatus which are used in the service of a public utility corporation have been designed to work and to last in their working as long as possible. The value of such items in any operating property is the value of the items to give their service, and if the power to give service is partly exhausted and the items are on the way to the point where severally they have to be discarded and replaced by new, there is a lessened power to serve in the plant represented at least by what the necessary replacement items not yet put in will cost. There is no reason why this partial exhaustion of capital or value should not be regarded in determining the value of the property and the rate of return which the consumer is to be called upon to pay to the investor for the use of the latter's property estimated upon the basis of the cost of that property less such depreciation. The consumer, however, should, in the rate that he pays for the service given by the properties, cover an amount which shall provide as part of the operating costs for the annual accruing depreciation in order not only to keep up the efficiency of the property as an operating property, but also to keep up the continued value of the property for service in the future. This value for service is what is really back of the securities which may be authorized to be issued by the company. In the present case, as the testimony shows, the properties, generally speaking, both gas and electric, are over twenty years of age, and of the electric properties the engines and generators are practically obsolete and would never be installed at the present time. They are used only as a standby plant for a few hours a year during the winter months."

**Evidence of "Going Value" Requisite—Unexplained Increases in Operating Expenses.**—In ordering a reduction in the gas rates of the Rutland Railway, Light & Power Company the Vermont Public Service Commission said the fact that a utility business is an active going business should be taken into consideration as evidence in determining present-day value, but no specific allowance should be made for going value when there is no evidence of early losses or cost of developing business and when, in addition, the property was purchased by the present operating company as a going concern. An enormous increase in operating expenses when no effort was being made to extend the business of the company and when, on account of a decline in prices, savings might reasonably have been looked for, and the fact that the results of the year's business showed a loss of sales and a great increase in the cost of carrying on the business, indicated poor management or a plan to curtail the business.

**Powers of Michigan Commission.**—Declaring its lack of power to abolish discrimination by an electric utility in favor of power consumers operating in a municipality where rates are limited by franchise, the Michigan Public Utilities Commission, in adjudicating a complaint brought against the Consumers' Power Company by the Alabastine Company, said it could neither increase the rates within the city to the rate charged a power consumer outside the city nor discriminate against other power customers outside the city limits by lowering the rate. "We think," said the commission, "it was the intention of the Legislature that this commission should not have the authority to set aside franchise rates, even if such rates are burdensome to the public or to the utility, unless, by mutual agreement between the municipality and the utility, the fixing of such rates should be submitted to it. We also believe that the only authority this commission has to remove discrimination is in territory where rates are fixed by this commission. Where there is discrimination in franchise territory, the courts will remove it."

# Recent Court Decisions

**What Constitutes Beginning of Construction Work Under Franchise?**—In City of El Dorado vs. Citizens' Light & Power Company, the city sought to annul a franchise granted to the company, permitting it to furnish lighting and water service, alleging among other things that construction work had not been begun by the time specified on a sufficient scale to fulfill the contract terms. The Supreme Court of Arkansas found for the defendant, declaring that where a franchise to construct and operate a system for furnishing light and water in a city provided that grantees within three months begin active operations and work in laying water mains, erecting lines and poles and constructing sufficient power plant and wells, and if powers granted were not exercised within six months the franchise should become void, the franchise is treated as a unit, and its only requirement was that work should be substantially commenced on the construction of the facilities as a single unit within the named period. Poles having been erected and wires strung within the required time, the court held that the condition had been met. (250 S. W. 882.)*

**Powers of New Hampshire Commission.**—In dismissing an appeal taken by the Plymouth Electric Light Company against the New Hampshire Public Service Commission, the Supreme Court of New Hampshire denied the company's contention that the commission was prohibited by law from lowering the rate base within two years after a previous reduction. The court held also that the commission's expert's procedure in taking as a basis of unit values average costs during a three-year period and deducting therefrom depreciation as of the date of valuation did not show a failure to give due weight to present-day values; that the sale price of all the assets and good will of the company was not a fair criterion of value, it being but the estimate of an individual and based largely on the report of an accountant hired by the utility; that records indicating actual operating expenses, though valuable, were not conclusive evidence of the requirements of the company, and that, having failed to keep its accounts as required by statute, the company could not complain because the expenses of other companies were considered in arriving at a rate base. An allowance of $20,000 a year for operating expenses of a company with an established value of $35,000 was held not inadequate. (120 At. 689.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

# Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

## J. H. Drake Made Vice-President Jersey Central P. & L.

John H. Drake has been appointed executive vice-president and general manager of the Jersey Central Power & Light Corporation, a consolidation of several utilities recently acquired by A. E. Fitkin & Company. Mr. Drake, who has had many years experience as a public utility manager, is in charge of the operation of all properties, with

J. H. DRAKE

headquarters at Morristown. Since 1912 he has been associated with the Morris & Somerset Electric Company, Morristown, N. J., one of the properties included in the consolidation, when he became its general manager. Six years later he was made vice-president and general manager, the office he occupied at the time of his recent appointment. He also served as vice-president and general manager of the Boonton (N. J.) Electric Company until it was merged into the Morris & Somerset Electric Company a year ago. Mr. Drake was formerly connected with the testing and foreign engineering departments of the General Electric Company. From 1903 to 1907 he was associated with Ford, Bacon & Davis and subsequently served as electrical engineer, in charge of overhead and underground distribution, both construction and maintenance, with the Chicago City Railway Company. For three years previous to his connection at Morristown he was superintendent of lighting of the Knoxville (Tenn.) Railway & Light Company.

**F. F. Martin,** auditor of the Louisville (Ky.) Gas & Electric Company, has been made treasurer of the company by the board of directors to fill the vacancy left by the resignation of T. B. Wilson. Mr. Martin will continue to perform the duties of auditor. He has been a member of the forces of H. M. Byllesby & Company since 1911, serving that organization on the Pacific Coast and subsequently in Chicago. He was transferred to Louisville in 1920.

## C. S. Walters Succeeds Plummer in Asheville

C. S. Walters has been made vice-president and general manager of the Asheville (N. C.) Power & Light Company, succeeding Harry W. Plummer, whose resignation became effective on July 1. Mr. Plummer has been connected with the company for twenty-six years and is one of the best known electric power officials in the state. Mr. Walters' early business connections were with steam railway operation in both transportation and traffic departments, and in 1909 he went with the Oregon Electric Railway as general agent, with headquarters at Salem, Ore. In 1911 he was appointed vice-president and general manager of the Walla Walla Valley Railway, an electric interurban and street railway in the State of Washington. In 1913, in addition to his duties as vice-president and general manager of the electric railway, he was appointed district manager of the Pacific Power & Light Company's gas and electric properties in the Walla Walla Valley, which position he occupied until going to Asheville.

**E. R. Wood,** president of the Dominion Securities Corporation and vice-president of the Brazilian Traction, Light & Power Company, was recently elected a director of the Northern Canada Power Company, Timmins, Ont.

**Van Horn Ely,** president of the American Electric Power Company, sailed for Europe today. Mr. Ely will be away for several months and while abroad will study transportation and public utility problems in various European countries.

**F. H. Farnum** has been appointed manager of the securities department of the Central Maine Power Company, with headquarters at Augusta, succeeding Percy H. Whiting, who recently resigned to head the customer ownership division of the securities department of Henry L. Doherty & Company, New York. Mr. Farnum has been associated with the Central Maine company for about six months. He recently resigned from the United States Army with the rank of major, and during the World War served overseas as chief of staff of the Fortieth Division.

## L. M. Klauber New President of Pacific Electrical Association

Lawrence M. Klauber, who was elected president of the Pacific Coast Electrical Association at the convention held recently in San Francisco, is general superintendent of the San Diego (Cal.) Consolidated Gas & Electric Company. Mr. Klauber has taken an active part in the affairs of the association he has been selected to head, and during the past year served as its first vice-president. Mr. Klauber's other activities in the National Electric Light Association have included membership on the electrical apparatus committee, chairmanship of the Pacific Coast engineering committee, the vice-chairmanship and chairmanship of the overhead systems committee and he is at present vice-chairman of the technical national section. He is also a member of the American Institute of Electrical Engineers. Mr. Klauber became associated with the San Diego Company in 1911 as new-business solicitor. Subsequently he served as engineer in charge of record department, superintendent of the electric department, assistant general superintendent, and in 1920 was promoted to be general superintendent, his present position. Mr. Klauber is a graduate of Stanford University and has been a frequent contributor to the technical press.

L. M. KLAUBER

**Harris J. Ryan,** president of the American Institute of Electrical Engineers, is spending a few days in New York in connection with the institute's affairs and is expected to leave for the Pacific Coast Aug. 3.

**Frank G. Baum,** consulting engineer, who has been spending some time in the East in connection with superpower development for the United States, left Saturday, July 21, for the Pacific Coast for a two months' visit and business trip.

**Wyndham S. Wallace** has been placed in charge of the work of the department of commercial and industrial lighting recently organized by Charles H.

Tenney & Company, Boston, for the use of properties under the Tenney management and other clients. Mr. Wallace was formerly manager of lamp sales for the McKenney & Waterbury Company, Inc., electrical supply jobbers, Boston, and was previously on the staff of the East Boston Lamp Works of the General Electric Company.

## Frank Howard Receives New Appointment

Frank Howard, general superintendent of the Ohio Power Company, was appointed assistant general manager on July 1 of the Ohio Power Company, the Ohio Service Company and the North Western Ohio Light Company, with offices at Canton, Ohio. Mr. Howard previous to his association with the Ohio Power Company as general superintendent acted in the same capacity for the Wheeling Electric Company and the eastern divisions of the Ohio Power Company, with headquarters at Wheeling, W. Va. Before 1913 he was located at Scranton, Pa., as superintendent of distribution for the Scranton Electric Company. All of these properties are subsidiaries of the American Gas & Electric Company of New York. Before his connection with these properties he was general superintendent and manager of the Standard Electric Light, Heat & Power Company, furnishing service to the territory located in the Lackawanna Valley between Pittston and Scranton, Pa.

**John C. Moore,** who has been with the Pennsylvania Power & Light Company as storekeeper for the past five years, has been promoted to the position of business manager.

**W. E. Thumith** of the Connecticut Power Company's Canaan office has been transferred to the Middletown division as sales manager, to succeed George H. Weatherbee, who recently resigned.

**John S. Gadbois,** formerly in the electric construction department of the Brooklyn Edison Company, is now engineer and office manager with the Lyme Electric Power Company, East Lyme, Conn.

**Lucius Rossiter,** formerly secretary and treasurer of the Terry Steam Turbine Company, Hartford, Conn., was elected vice-president and treasurer of the company at a recent meeting of the board of directors, and R. L. Thomsen, sales manager, was elected secretary. President D. H. Thomson was re-elected.

**N. A. Wolcott,** president and general manager of the Packard Electric Company, Warren, Ohio, was the guest of honor at a banquet given at Brookside Inn, Cortland, on Monday evening, July 16. On that day Mr. Wolcott completed twenty years of service with the Packard company and as an expression of appreciation a group of executives of the company and of his closest friends and business associates planned the surprise.

## C. A. Sears Heads Iowa Section

C. A. Sears, manager of the Mississippi River Power Company, Keokuk, Iowa, was elected president of the Iowa Section of the National Electric Light Association at the annual meeting held recently at Mason City. Mr. Sears was born in Portland, Ore., and received his education and early training in the construction and operation of electric plants in that state. After serving in the transport service during the Spanish-American war, he became connected in 1901 with Stone & Webster at Seattle, Wash., where his work was principally in connection with water-power development and operation. These activities included the construction and operation of the Electron plant of the Seattle Electric Company, charge of construction of the Snoqualmie and

C. A. SEARS

White River (Washington) hydroelectric developments and construction of the Keokuk development. After the Keokuk plant of the Mississippi River Power Company was started in 1913, Mr. Sears filled the position of general superintendent until September, 1919, at which time he was made manager of the company. He has been active in the National Electric Light Association as a member of the electrical apparatus and hydraulic power committee and as a member of several committee of the Mid-West Division.

**A. L. Board,** manager of the Lodi district of the Western States Gas & Electric Company for several years, has been promoted to the position of assistant superintendent of electric distribution. H. D. Miller of the Stockton office has succeeded Mr. Board at Lodi.

**E. F. McKay,** who is the acting manager of the Oklahoma Utilities Association, is a lawyer whose legal experience has been related directly to the utility industry. Following ten years with metropolitan daily newspapers and three years as owner and editor of a weekly and daily in Oklahoma, he was admitted to the bar. His legal experience includes ten years with the Oklahoma Corporation Commission, two years with the gas division of the Empire Companies at Bartlesville, Okla., and one year in private utility practice.

**M. C. Wheyland,** formerly lieutenant in the United States Navy, has recently joined the San Diego (Cal.) Consolidated Gas & Electric Company in the capacity of assistant superintendent of electric production.

**J. W. Ward** of Latrobe, Pa., formerly president and general manager of the Ward Tool & Forging Company, has been appointed general superintendent of the Porcelain Insulator Corporation at Lima, N. Y., having direct charge of all manufacturing operations.

**B. L. Delack,** formerly manufacturing engineer of the Erie Works of the General Electric Company, has been appointed assistant manager of the Erie Works. Mr. Delack became associated with the General Electric Company in the testing department at the Schenectady Works in 1903. Two years later he entered the railway motor engineering department at Schenectady, serving in various capacities until transferred to the Erie Works, Jan. 1, 1920, as manufacturing engineer in charge of motor manufacture, in which capacity he continued until the present.

**William J. Merten,** metallurgical engineer of the Westinghouse Electric and Manufacturing Company, has been appointed a member of the committee on heat treatment of carbon steel of the National Research Council and has also been elected chairman of the Pittsburgh Chapter of the American Society for Steel Treating. Both honors have been given to Mr. Merten because of his accomplishments in the metallurgical field, and are evidence of recognition of his work by metallurgists and metallurgical organizations. His appointment to the committee on heat treatment of carbon steel of the National Research Council, which is also known as the Henry M. Howe Committee, is for a period of three years, and his election as chairman of the Pittsburgh Chapter of the American Society for Steel Treating is for the ensuing year.

**E. R. Treverton** has recently rejoined the Henry L. Doherty & Company organization in the securities department and is handling the customers' ownership sales in the Ohio Public Service Company's property at Elyria, Ohio. Mr. Treverton was formerly associated with the Westinghouse Electric & Manufacturing Company at East Pittsburgh and assisted in designing and engineering for its various shops there a scientific industrial lighting system. For three years he was with the illuminating engineering department of the Westinghouse Lamp Company, later becoming chief engineer of that department. Prior to its incorporation in the ELECTRICAL WORLD he was managing editor of the *Lighting Journal,* New York, and took an important part in the work of the Illuminating Engineering Society's work. Since the war he has been engaged in the management of electrical properties in the South.

# Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

## The "Spoiled Child of the Industry"—I

### A Discussion of the Character of the Electrical Contractor—How His Condition Has Been Improved in One Locality—How the Industry Has Benefited

By W. R. Herstein
Vice-President Wesco Supply Company, Memphis, Tenn.

ANY discussion of the electrical contractor as a class must take into consideration the fact that the class is composed of an almost infinite variety of individuals. The average, or composite, personage has a character as many-sided and as full of whims and fancies as the proverbial spoiled child. I use the simile of the spoiled child purposely, because many circumstances conspire to make the contractor the spoiled child of the industry. His lack of adequate business preparation, frequently his lack of common school education, his incomplete scientific training, his inadequate financial resources, the intense and destructive competition to which he is subjected by his own class and those not of his own species, his undefined status in the industry—all have a tendency to convert his character into one of suspicion, resentfulness, perverseness and frequently hopelessness as to the future.

If I seem to draw an unpleasant picture of the average contractor, it is only because we must realize and acknowledge the adverse circumstances influencing his destiny if we sincerely desire to be of help to him. His place in the general picture cannot be vacated. His title to recognition cannot be denied. Production and distribution of electrical supplies are of no avail without a medium of their practical application.

#### Obstacles He Faces

The work of installation is the particular function of the contractor. It is quite true that in this he is frequently thwarted by amateur wiremen and would-be electricians, who appear on the payroll as janitors, engineers, building superintendents, and whatnots, as well as by responsible business men, employing irresponsible journeymen in the mistaken hope of cheapening the job and saving a few dollars, but in the main the contractor is the man upon whom we must depend for installation, and the degree of success which the industry is to meet in using him for this purpose and in training him to be both satisfied and prosperous depends upon our method of approach and our treatment of him after the contact has been established.

For this purpose a sympathetic understanding and appreciation of the contractor's problems are essential. I have already enumerated what I believe to be the fundamental obstacles lying in the pathway to success. Any assistance the jobber, the manufacturer and the central station may render him in overcoming these obstacles will result in an improvement of the contracting industry as a whole, and any assistance the jobber may give him as an individual will result in his becoming our customer and giving us his business, which, after all, is the thing we desire.

#### Tackling the Problem

When I embarked upon the electrical jobbing business, some twenty years ago, one of the facts which first became patent was that the electrical contractor was a poor sort of customer. A superficial investigation brought out the chief reasons for this, as already enumerated, lack of education, both business and scientific, and intensive competition, coupled with an almost complete lack of ambition beyond the earning of his daily bread. The first step, therefore, was obviously to implant ambition and hope in him, and then to secure his consent and cooperation in the direction of education for himself and his competitors. This was done, first, by heart to heart talks, then by words with groups, and finally by organization, pointing out always the unlimited possibilities of the industry, the fact that business men acquired a competency in other lines which were equally crowded and less exclusive, and that properly directed effort as individuals and as a body could not fail to bring adequate reward.

Not all the subjects worked upon were responsive to the treatment. Some of them were flat failures, as would have been the case in any other industry. The majority, however, when once convinced that their case was not hopeless, began using their brains, not only in their own immediate business, but for the benefit of the entire local situation, and thereafter the task of the devoted few who had instigated the evolution became greatly simplified.

#### Education Plus License

The first effort was toward self-education. The body endeavored to teach its members the first principles of profit-making; the use of common sense in business. The elimination of competition, though often discussed, was never attempted. Competition between the more intelligent and progressive contractors was by degrees established upon a sensible plane. Competition from the curbstone or carpet bag type was recognized as an evil which could not be entirely suppressed, but which was regulated to a fairly satisfactory extent by securing the enactment of a state statute requiring the examination, licensing and bonding of contractors, so that those who stood the test represented at least a class somewhat superior to the journeyman. As a by-product, the statute put a stop to the practice of journeymen deserting their employer today and going into competition with him tomorrow.

The good will of the dealer was furthered by assuming the leadership in an electrical league, by inducing the central station to assist in promotion campaigns and electric

shows, by planning and executing co-operative newspaper advertising ventures calculated to gain public consideration of the contractor and his functions, as contrasted with the competition offered by irresponsible or non-electrical concerns. Friendly feeling was increased by a conscientious effort to avoid direct competition between jobber and dealer, as well as assisting the dealer, whenever called for, upon specific jobs.

### THE PRACTICAL RESULT

These policies and practices, while applied intensively to our home town, were extended, in whatever degree might be possible, to outlying territory. It frequently happened that we were able to assist in organizing mutual welfare efforts in neighboring cities and in influencing competing jobbers to respect trade functions and rights as established by local customs. The ever-present idea was to bring about the recognition of a well-defined identity of interest between jobber and contractor, so that trade relations would not depend upon the presence of a salesman for each separate order, but that a daily and constant flow of orders would result from a feeling on the part of the dealer that he might rely upon the jobber's prices as being fair, the jobber's integrity dependable and the jobber's friendship of real advantage and tangible value.

The practical result of all this was not, of course, to secure all the available business in the territory, or even in our home town, but the expense of securing business was greatly lessened, or, to put it in another form, the same amount of effort secured a greatly increased volume of business. In addition, the moral effect upon the salesman was decidedly advantageous. A kindly reception from his customers increased his aggressiveness in looking after old and securing new accounts, and the friendly feeling existing between his house and the trade made him a happier and at the same time a more contented employee.

The result of my twenty years' experience in selling the contractor leads me to believe that he is not only the jobber's legitimate customer, but that he is the jobber's golden opportunity. Some of the obstacles to the further development of this opportunity I will outline in my succeeding paper.

# The Status of the Electric Vehicle

## Too Large a Proportion of Repeat Orders a Sign of Weakness—The Attitude of Central Station and Manufacturer

BY S. W. TRAWICK
New Orleans Public Service Company

THE electric vehicle has been manufactured and available for practical commercial purposes for nearly a quarter of a century. For the greater part of this period the growth of the industry has been comparatively slow and discouraging when compared to other types of motor vehicles having neither the theoretical nor practical advantages of the electric truck.

Considering the situation from a historical as well as a commercial standpoint, the progress made by the electric truck in the past three years, however, has been remarkable. It is needless to go into the data in elaboration of this statement, as the fact is outstanding and the figures are available from many sources.

However, to analyze the situation further, we may well take one item of these accumulated data as applied to the development in New York City for the year 1922. More than 86 per cent of electric truck sales in New York during 1922 were "repeat" orders.

### EXCESS OF REPEAT ORDERS

The activity in New York City has been perhaps proportionately greater than that in any other section of the country, due to the very close and intelligent co-operation of central station, manufacturers and their representatives. This co-operative selling effort resulted in the development of new business to a gratifying extent, yet 86 per cent of the total sales were repeat orders, or, in general, orders secured from fleet owners already sold on the idea and actually using the electric truck. This record is one of the greatest compliments that could be paid the designers and builders of electric vehicles and batteries. It proves beyond a doubt that the theory and practical development of the electric vehicle is all and perhaps more than has been claimed by its sponsors. It is the last word in sales argument.

Upon studying the subject still more carefully it becomes apparent that the repeat orders (predicating the situation throughout the country upon the record quoted) are so far in excess of new business secured that there might be some weakness in the methods, arguments and logic now in accepted use for the widening and developing of the practically untouched field of possibilities.

### CENTRAL-STATION ATTITUDE

Very noticeable activity has manifested itself recently as indicated by the interest taken by central stations all over the country, by the augmented and highly attractive advertising campaigns carried on by truck and battery manufacturers, by the detailed studies and carefully compiled data available through the National Electric Light Association and by the many splendidly written and widely distributed articles from the pens of enthusiasts of national repute. Close co-operation is said to exist among all the allied interests of the electric vehicle, but does it really exist as perfectly as we would like to believe?

The central station organizations, although vitally interested in the filling of the so-called "night valley" and theoretically in favor of the electric vehicle, strange as it may seem, occasionally assume a slightly antagonistic attitude, and in some cases are not willing even to consider the electric truck as applied to their own use. The greater portion of this feeling results from lack of knowledge, misinformation, lack of interest and the mistaken idea that excessive speed capacity is an essential in their hauling units.

Further, no provision is made for the handling of the units of the small fleet or single truck owner. The electric vehicle representative of the central station (if it has progressed so far as to have a representative) is usually classed as a sort of supernumerary solicitor and is given little or no support and backing. The company representative takes what figures he can collect and, by much talk and dwelling upon the phenomenal success of the electric truck in other localities, is supposed to induce the rather dubious public to invest large sums of money in what to it is an experiment, no doubt a success in other localities and under other conditions, but very possibly not exactly fitted for its own particular use.

The average truck and battery representatives feel strongly that

the central-station organization is not giving them full co-operation. They feel that the usual representative of the utilities is not so well equipped as they themselves for the merchandising of their product. And at times they somewhat resent the active entry of this representative in the field of their particular and pet prospects.

The manufacturer of electric trucks, well satisfied with the recent exceptional increase in the demand for his output and operating near, if not up to, his production capacity, is more than half willing to let the repeat orders of enthusiastic owners constitute the bulk of his business. He is inherently slow in deviating, even in the smallest degree, from the established path of fixed procedure, no matter what logic, pressing necessity or prospective development is placed before him.

He expects the central station organization, his own representatives and satisfied users of his product to develop the field and clear the path of all obstacles, then build to the demand.

### THE ONE BEST ARGUMENT

There have been vast amounts of money expended in talk, print and propaganda, and volumes of most attractive and accurate facts spread broadcast, but no provision has ever been made, except in isolated cases, for the most successful, practical and unbeatable argument in favor of the electric truck; that is, the practical demonstration of the unit to the prospect over a reasonably long period, in his own work and under his own observation—all at a reasonable or nominal cost to him.

The truck in operation for the prospect will in practically every case sell itself. In witness thereto, again consider the fact that 86 per cent of all sales in New York City during the year 1922 were "repeat" orders.

# Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

ALTHOUGH much activity is seen in the appliance and conduit markets the general situation is of little feature. Sales by the jobbers are said to be running close to ordinary requirements of any midsummer period of the last two years. However, the trade is optimistic and is preparing for the fall months, when a great deal of construction will be completed or nearly completed.

In the New York territory prices of sockets dropped approximately 9½ per cent during the week. Wire prices are slightly softer, with armored cable prices remaining quite firm after the important reduction of two weeks ago.

## Porcelain Scarcity Hampers High-Tension Equipment Production

HIGH-TENSION equipment sales are now at a stage where production overshadows the previous main issue of order taking. In fact, this condition has been in existence for some time since all manufacturers felt the renewed response in the industry which started in the fall of last year.

But now production is seriously hampered by the slowness of porcelain arrivals from the insulator companies. One manufacturer declared that his business could absorb twice as much porcelain as he was now receiving. The situation in that keynote industry appears to be contingent on the old economic supply and demand law where the demand far exceeds the supply. Sentiment among the high-tension people regarding these delays appears to indicate that this situation might well lead to the formation of other producers of porcelain because of the present limited capacity. No difficulty is experienced in procuring other raw materials, such as copper and steel. So deliveries which formerly took a week are now being held up several weeks or more. Deliveries have become a function of porcelain receipts. However, while this situation is none too good, it is no worse than in other lines of business where conditions are more acute.

In order to relieve as much of this congestion as possible, the manufacturers are strongly urging the sale of their standardized equipment in place of special designs; they are doing this in their effort to lessen the time utilities must wait their turn in obtaining special equipment. Naturally with production standardized on certain classes of equipment, which has been developed through years of experience, any variation in design must necessarily await its turn because it conflicts with the regular process of production.

The distribution of the present active demand is very widespread throughout the country since central-station power developments are practically uniform all over. But particular activity is occurring in New England, along the Atlantic Coast and in the Middle Western territory. Of the industrials, the cement mills, the coal mines and the steel mills appear to be the most active from the volume of business received. As to the type of equipment ordered, the manufacturers declare that about 70 per cent of their sales are for outdoor use. And of this number about 50 per cent has a rating of 33,000 volts or over. Regarding the trend toward higher voltages, the rate of development can be taken from a thought expressed by a manufacturer of liquid fuses. With each issuance of his catalog, he has been required to develop and manufacture still higher voltage fuses so that his present highest capacities are rated at 132,000 volts. This high-voltage trend in fuses is also paralleled in the design of other protective equipment which includes lighting arresters, busbar supports and disconnecting switches.

Business for all the companies is traveling on a higher plane than existed last year. For several firms, the orders arriving this spring have been the greatest in the history of those organizations. One concern is operating 100 per cent better than for the same period in 1922. Prices remain firm around the level established by the increases announced last May, and indications are that the drive for further quantity production will absorb the future increases in raw materials before becoming reflected in higher prices for high-tension equipment.

## Issues Federal Specifications for Purchase of Snap Switches

THE Federal Specifications Board has just issued Standard Specifications No. 62 for the use of departments and independent establishments of the government in the purchase of snap switches. The latest date on which this specification shall become mandatory is Sept. 15, 1923. The specification may be put into effect, however, at an earlier date if desired.

According to the specifications by the government all snap switches must be constructed so that the current-carrying parts shall be mounted on noncombustible, non-absorptive, insulating bases, such as slate or porcelain, and the holes for supporting screws shall be countersunk not less than ⅛ in. There shall in no case be less than $\frac{3}{64}$ in. space between supporting screws and current carrying parts.

Included in the specifications are the following points of interest:

In switches designed only for use on heating devices and which have special bases such that they are not adapted for wall mounting or other general uses, the sealing compound may be omitted provided live parts are countersunk ⅛ in. and screws and nuts are staked or otherwise reliably prevented from loosening.

In surface snap switches used as integral parts of electric heaters, the sealing compound may be omitted provided live parts are countersunk, ⅛ in. on under side of the base, nuts and screws are staked or otherwise reliably prevented from loosening, and the requirement as to countersinking is complied with.

For sealing nuts or screw heads in surfaces which upon installation of the switch will be immediately in contact with the sur-

ace upon which the switch is mounted, the countersinking shall be such that there will be a full $\frac{1}{8}$ in. of sealing over the live part and below the surface of the base. For other locations $\frac{1}{16}$ in. will be accepted provided the sealing is reliably held in place.

Sealing compounds shall comply with the specifications of Underwriters Laboratories for materials of this class.

All switches shall have ample metal for stiffness and to prevent rise in temperature of any part over 54 deg. F. (30 deg. C.) at full load. The whole device shall be mechanically well made throughout.

Iron or steel, plain or plated, shall not be used for parts which are depended upon to carry current or for movable wire-binding screws or nuts, or except where soldering lugs are used, for any wire-binding screws or nuts.

Insulating materials used for buttons and handles shall retain their insulating and mechanical strength when subject to continued use, and shall not soften at a temperature of 150 deg. F. (65 deg. C.).

## Boiler Deliveries Now Running at Five and Six Months

OF GREAT importance in the boiler manufacturing industry is the improvement of raw materials deliveries to the plants in both the Eastern and Middle Western territories. Four months ago deliveries of raw materials were running at the rate of three to four months from the Ohio and Pennsylvania mills. Now those same deliveries can be had in from five to six weeks.

With this improvement of raw material deliveries to the boiler manufacturers has come deliveries of boilers and economizers at the more favorable period of between five and six months in place of deliveries of between seven and eight months, which prevailed during the slower production schedules of the steel mills.

Business by boiler and economizer makers is running 70 per cent ahead of the first half year of 1922. No near advances or decreases in prices are expected by the leading manufacturers. They are of the opinion that business has hit its normal stride and will continue so for at least six months. The price of $2.50 for steel plate prevails, and these makers do not believe that either possible higher labor costs at the steel mills or increased consumption of steel by other industries will cause much marking up or down on steel plate prices during the remaining months of 1923.

The three-shift eight-hour a day plan which has been put into effect in some of the independent steel mills of Ohio has not taken any labor from the boiler plants in that state due to the fact that the boiler manufacturers are paying unskilled labor at the much higher rate of 50 cents an hour.

According to an important maker of economizers the use of economizers in this country has passed through what might be considered a cycle, being in common use a number of years ago, then for a period falling rather into disuse, and at the present again coming into greater favor. While economizer installations have never been as general in this as in other countries, this country appears to be approaching European practice more nearly, and it is definitely stated by this firm that economizers are receiving today more favorable consideration than ever.

## Flexible Armored Cable Reduced 12 per Cent in Chicago

ELECTRICAL jobbers in Chicago say that business is continuing at a normal rate. An important reduction in flexible armored cable was announced this week, when the price on No. 14 single-armored was reduced to $39 per 1,000 ft., Pittsburgh, a reduction of about 12 per cent over the previous prices. This puts the conductor back at the price quoted in January of this year. While there has been an advance in steel prices the decline in the copper market no doubt accounts for this reduction. It is expected that the price will advance again later on in the summer or early fall.

No further reduction in rubber-covered code wire is announced, although one manufacturer is offering wire at about 20 per cent off the prices quoted prior to July 1. Also, lead-covered cable is being quoted at prices in effect last February. Certain types of motors advanced 10 per cent again.

High-tension equipment sales are still keeping up at a fair rate; one manufacturer's sales are averaging 100 per cent higher this year than last. Pole line hardware demand remains active.

The conduit situation is the same with firm prices and long delivery. It is not expected that a price reduction will be announced, as merchant pipe prices remain firm and the pipe is hard to get in all sizes. Watchful waiting seems to be the password of the electrical trade in Chicago, as it appears that they are holding off placing commitments. Building activity still continues high, although labor shortage is retarding the jobber's business.

## New England Stocks Being Kept to Present Requirements

MIDSUMMER quiet with a disposition to hold new business until later in the season characterizes New England wholesaling trade as the month closes. Stocks are being carefully kept close to present requirements and the absence of heavy inventories is one of the chief grounds for expecting an active fall volume of sales. Prices are steady this week.

Appliance sales are very active and in some quarters the demand for electric ranges is outrunning the supply. Industrial plant improvement work is absorbing considerable motor and control equipment at this season. Retail trade in general is good in this section. Cotton textile mills are curtailing considerably and at Holyoke, Mass., a strike of firemen has thrown 4,000 employees out of work in twenty-seven paper mills. Building operations continue in good volume.

## Americans Overcoming Difficulties in English Market

SOME exceedingly interesting pioneer work is being done in England at present by a number of American manufacturers of large household electrical appliances. Fundamentally the market offers the same opportunities for development that it does in this country. Electric vacuum cleaners, clothes washers and ironing machines supply a need that is as universal in the British Isles as in America, but the process of popular education and market development has not been carried as far nor will it be as easy to work up.

One difficult factor in the selling of the larger appliances in England is the increased cost which is entailed in export selling. A washing machine that sells in this country for $150, for instance, will have to be sold in England for more than $200 in order to cover ocean freight and other incidental expenses. Both steamship and British railroad freight, however, will probably be reduced somewhat when it is possible to establish a specific classification on these goods. At present an electric clothes washer is classified at the same rate as an electric motor, because it embodies a motor in its equipment. The American exporter must ship his motors separately and assemble the machines in England or he must pay the high rate. An effort is being made, however, to establish a more favorable classification, and this has already been accomplished in some individual cases. In one instance the freight rate from London to Glasgow has been reduced from 40s. to 19s. by reclassification.

Another difficulty lies in the multiplicity of voltages, which are encountered in English communities. There are seventeen voltages in London alone, with which the manufacturer of domestic appliances must contend. However, progress is being made toward standardization and already 75 per cent of the utilities are furnishing energy at 250 volt, 50 cycles, alternating current, or 220 volts direct current. The trend is toward the adoption of this as a general standard.

As a result of all this, these Ameri-

## Comparative Prices of Station Supplies

| | Current Price | Four Weeks Ago | One Year Ago |
|---|---|---|---|
| Soft steel bars, per lb. | $0.0337 | $0.034 | $0.0276 |
| Cold finished shafting, per lb. | 0.0428 | 0.042 | 0.0355 |
| Brass rods, per lb. | 0.1825 | 0.1850 | 0.1650 |
| Solder (half and half), per lb. | 0.276 | 0.2862 | 0.21 |
| Cotton waste, per lb. | 0.1231 | 0.1231 | 0.101 |
| Washers, cast iron (¼-in.), per 100 lb. | 4.66 | 4.66 | 3.83 |
| Emery, disks, cloth, No. 1, 6-in. diameter, per 100 | 3.08 | 3.08 | 3.11 |
| Machine oil, per gal. | 0.349 | 0.349 | 0.36 |
| Belting, leather, medium, off list | 37% | 42½% | 46½% |
| Machine bolts, up to 1-in. x 30-in., off list | 44½% | 44½% | 53½% |

can electrical household appliances are salable practically only to people of means, and it is not possible at the present time to develop any considerable market among the middle class homes which must eventually provide the greater part of the demand. American manufacturers are therefore concentrating on the English country home and the English town house, both of which today are very inadequately supplied with laundry facilities. For the most part there are no central heating plants, and in the country the laundry work is usually done in outside laundry buildings where the water is heated by stoves. There are also very few stationary washtubs in England, and in a great many cases two washing machines are being sold, one for the washing and one for the rinsing, and the machine used for washing is equipped with a gas heater, so that it can heat its own water.

## Thinks Mexico Will Be America's Best Foreign Market

MEXICO will soon be our best customer if conditions there continue to improve as rapidly as they have recently been doing, according to C. V. Allen, manager for Mexico of the Westinghouse Electric International Company, who has returned to the United States on a short business trip.

Mr. Allen is enthusiastic about the future of Mexico. He says the climate is ideal, the people are intelligent and industrious and there are enormous natural stores of valuable minerals. The present government, moreover, is doing its best to get the country straightened out politically and Mexico is now in better condition than it has been since the revolution. The railroads, most of which are operated by the government, are in good condition and cover the country very thoroughly. The government telegraph and postal services also can be depended upon by business men just as much as in the United States. Already the number of industries has increased considerably and all that is needed to make Mexico one of the most productive countries in the world is foreign capital.

One of the main hindrances to progress in Mexico in the past, said Mr. Allen, was the ignorance of most of the poorer Indian class, which makes up about 12,000,000 of the 14,000,000 population of the country. The present government is doing its best to overcome this evil and is spending a great deal of money on popular education. Already the good effects of this policy can be seen, for the younger generations are learning to read and write.

In future years machinery will be the largest import from the foreign countries, for there are practically no machinery manufacturers in Mexico, and with the development of industry, much machinery will be needed. Already there are a number of large textile mills, some owned by foreigners and some by natives, and shoes are, of late, being manufactured in large quantities. With the development of mines and oil fields, other imports of machinery will be needed. To America, rather than to Europe, Mexico will naturally turn for its imports, because the nearness makes prompt delivery possible and reduces the expense of transportation. This is not true of many of the countries of South America, which are actually nearer to Europe by boat than to the United States. For the machinery trade, this proximity is of particular importance; the necessity of securing repair parts with the least possible delay is a great advantage that American machinery has over competitors in European countries.

## Betterment Noticed in Demand for Rigid Conduit

A DECIDED increase in the demand for steel conduit was reported in that market last week. With the near completion of many new apartment houses and office buildings in the large cities, the largest volume of the last fifteen months is now on the move, according to the manufacturers and jobbers of the East and Middle West.

Prices continue firm at the mills, although production is continuing at a high rate. Producers estimate that the elimination of the twelve-hour day will add over $4 a ton to average costs of manufacturing pipe, and as the profit margin is not large at current levels, some take the attitude that it would be better to stop production than cut prices so soon before the largest business is expected from jobbers.

Jobbers, however, feel that the demand will soon grow to unusual proportions and that their now well-proportioned stocks will soon be consumed on the rising market. Three jobbers in the Eastern market expect higher prices will come within the next two weeks. Black conduit, ½-in., per 1,000 ft., is being quoted at $61.10, and white at $66.16. One inch is at $112.06 for the black and at $122.19 for the galvanized. One-inch black elbows are at $19.26 and white $21.46. One-inch black couplings are at $10.65 and white $11.42.

## Armored Conductor Drops 20 per Cent in San Francisco

BUILDING construction in the San Francisco territory is showing a seasonable lull. There has been no depression, but a recent period of caution has its compensation in the fact that it prevented the tendency to pyramid orders.

Armored conductor and all cords have dropped about 20 per cent. Rubber-covered wire has declined about 10 per cent. The Christmas tree outfit season is beginning, with lower prices, improved quality and practical clearance of all stocks carried over. Conduit is again showing shortages, particularly of larger sizes, in face of large inquiries. Schedule material prices are still firm despite a 10 per cent drop in fuse plugs and cartridge cutouts

## The Metal Market

A CHEERFUL and optimistic tone prevails in the metal markets although buying during the last week has not been at all active by the electrical interests. On the whole sales are better than those of the week before.

Production of copper this month is expected to show a decline from that of June owing to the shutdown of some of the smaller producers in this country. Several of the smaller properties have shut down since the cessation of operations by the North Butte Mining Company because of lower prices for the metal and increasing costs of operation. Some small producers which resumed operations recently have been holding on, but it is believed that within a short time they will have again suspended operations which are resulting in net losses due to high costs.

Producers are surprised that buying of substantial tonnage of copper could have been deferred so long, but they are not yet much alarmed about it; they feel that consumers are allowing their stocks to run to the lowest possible point and that September requirements remain to be ordered. statistically copper is in excellent position, and as the producers seem financially able to carry what copper they have on hand for a few weeks longer, no panic to market copper at any price that it will bring is expected. The metal is going well into consumption, most rolling and brass mills operating at as close to capacity as labor supplies will allow.

During the week, producers have been encouraged by increased export business, though the total volume cannot yet be called large. Both Germany and the Orient have entered the market again, and further supplies have been purchased for Scandinavian consumption.

Finished steel prices remain remarkably stable and inasmuch as prices have held so long during a comparatively dull time the buyers are not so confident that recessions will take place, particularly since the fall buying movement cannot be many weeks off.

NEW YORK METAL MARKET PRICES

| | July 17, 1923 Cents per Pound | July 24, 1923 Cents per Pound |
|---|---|---|
| Copper, electrolytic | 14.75 | 14.75 |
| Lead, Am.S.& R.price | 6.00 | 6.00 |
| Antimony | 6.75 | 6.75 |
| Nickel, ingot | 27.00 to 32.00 | 27.00 to 32.00 |
| Zinc, spot | 5.90 | 6.10 |
| Tin, Straits | 38.08 | 38.08 |
| Aluminum, 98 to 99 per cent | 26.00 to 27.00 | 26.00 to 27.00 |

**Platinum Consumption by Electrical Manufacturers.**—According to reports just issued, electrical companies consumed 24,988 troy ounces of platinum in 1922. In 1921 these manufacturers used up 20,574 troy ounces. In both years the electrical industry was second in consumption to the jewelry manufacturing industry, which used 108,527 ounces in 1922 and 101,258 in 1921.

# Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

## Babcock & Wilcox Company Sells Its Sixty-first Economizer

When a sales bulletin on "Wrought Steel Economizers" by the Babcock & Wilcox Company, New York City, was distributed in February, 1921, it gave a list of sixteen orders for such equipment taken up to that date. Last week the company's order books showed a list for a total of sixty-one economizers.

According to A. G. Hall, vice-president of the company, this signal progress in introducing these economizers is gratifying, particularly in view of the relatively small proportion of "Babcock & Wilcox" boiler jobs with which such equipment can be installed advantageously. So far as the company knows, only two installations of high-pressure economizers have been ordered from other manufacturers for use with "B.&W." boilers.

## General Electric Transfers Gear Manufacturing to River Works

The manufacture of turbine reduction and ship propulsion gears heretofore carried on at the Erie Works of the General Electric Company is being transferred to the River Works, West Lynn, and will be consolidated there with the manufacture of other metal gears and pinions.

The design engineering on all metal gears and pinions, except those used with railway motors, will be under the direction of A. A. Ross, whose headquarters will be transferred from Schenectady to the River Works.

## Form New Tape Firm in St. Louis

A new company has been formed to operate the friction and rubber insulating tape department of the former St. Louis Rubber Cement Company, located in St. Louis. This company is called the Superior Insulating Tape Company and is specializing in high grades of electrical friction and rubber tape. The officers of the new company are: J. A. Schweig, president; E. Olsen, vice-president; J. Miller, secretary, and A. M. Freund, treasurer.

## Russell Secures More Space to Manufacture New Iron

The Russell Electric Company, manufacturer of electrical appliances, 340 West Huron Street, Chicago, has recently rented the large basement in the building it occupies and has moved all of its heavy machinery for manufacturing purposes into those quarters, thus giving it 10,000 sq.ft. of floor space for the assembling of its new flatiron.

Officials of the company state this new flatiron has met with exceptional favor from the trade and predict that sales will be limited only by its production facilities.

## Edison Electric Appliance Sales Show Large Increases

Electric range sales by the Edison Electric Appliance Company, Inc., Chicago, are exceeding those for the two springs months, April and May, which was a period when range sales were reported as 75 per cent above the corresponding period of 1922. The outlook for increased business by this company in October and November is very good due to the fact that a great deal of residential construction will have been finished at that time.

In keeping with the growing sales of ranges, the general market for heating appliances is increasing by leaps and bounds. It is said that this year will be the largest in the company's history. According to officials of the company, in the first quarter of 1923 sales to jobbers in the Chicago territory increased 53 per cent over the same period of 1922. Production of irons is at the rate of one iron every six seconds, and ranges at the rate of one every four minutes.

## Westinghouse Bookings and Billings Gain $15,530,205

Official bookings and billings of the Westinghouse Electric & Manufacturing Company for the first three months of the fiscal year ended June 30 showed an increase over the corresponding period of 1922 of $15,530,205 in new orders taken and advance of $9,381,177 in goods billed out.

The following tabulation shows bookings and billings for the quarter ended June 30, 1923, and compares with that quarter of 1922:

| | Quarter Ended June 30— 1923 | 1922 | Inc. |
|---|---|---|---|
| Bookings | $47,649,129 | $32,118,924 | $15,530,205 |
| Billings.. | 35,094,884 | 25,713,707 | 9,381,177 |

Bookings for the quarter ended March 31, amounting to $45,741,000, showed an increase of approximately 51 per cent over the corresponding period of the year previous, while billings of $39,537,000 compared with $22,712,700. Bookings for the first three weeks of July are over $5,000,000 in excess of those of the first three weeks of June. Unfilled orders of Westinghouse Electric are approximately $12,500,000 greater than at the beginning of the fiscal year.

**The Hirsch Brothers Machinery Company**, El Paso, Tex., has just completed its new warehouse and machine shops and is seeking further connections with manufacturers of all kinds of machinery to represent it in western Texas, Arizona, New Mexico and the northern part of Mexico. The company is particularly interested in electrical equipment, boilers, electric pumps, etc.

**The Vaughan Electric Company**, 4220 University Way, Seattle, is planning the installation of a plant in a building at 4240 University Way for the manufacture of electric fixtures and equipment. The company recently acquired the property and business of the M.&M. Electric Company, Seattle, and is concluding negotiations for the purchase of the plant and equipment of the Sterling Electric Company, Tacoma, Wash. It is purposed to remove some of the latter machinery to Seattle.

**The Niehoff Corporation**, recently organized, has leased a plant at 224 West Illinois Street, 40 ft. x 100 ft., and will manufacture magnetizers, coil springs, bridges, platinum and tungsten contacts. Officers are P. G. Niehoff, president; Wilson Compton, vice-president, and E. A. Harrington, secretary and treasurer.

**The Jones, MacNeal & Camp Manufacturing Company**, Otis Building, Chicago, recently incorporated, has a plant at Warsaw, Ind., and will manufacture electric steel drills and portable drill stands. Officers are Kenneth MacNeal, president, and G. W. Wilson, vice-president.

**The Electrolock Manufacturing Company, Inc.**, Grove and Washington Streets, Vicksburg, Miss., recently organized, will operate an assembling plant for the manufacture of special locking devices. It has contracted with Gustave Lidseen, 832 South Central Avenue, Chicago, general machinist, for the production of dies and steel parts, and with the Cutler-Hammer Manufacturing Company, Milwaukee, for the manufacture of electrical parts. Later it is proposed to establish a plant for parts production. W. Hemingway, Jr., heads the company.

**The Line Material Company**, New York City, announces the establishment of its New England warehouse, 128 Sidney Street, Cambridge, Mass.

**The Republic Lamp & Fixture Works, Inc.**, 732 Daly Street, Philadelphia, manufacturers of lighting fixtures, has leased two floors in the building at 610 Arch Street for extensions.

**The Dillon Electric Company**, Canton, Ohio, has completed a two-story and basement addition, 70 ft. x 105 ft., which will double the floor space.

**The Canadian Westinghouse Company**, Hamilton, Ont., has awarded a general contract for the erection of a $200,000 addition to its plant. This will be a part of the West Hamilton plant and will be the first of a series of buildings to be erected at a total cost of $1,500,000.

## Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Australia (No. 7,269) for electrical household appliances, glassware, bells and buzzers and motors for household and manufacturing purposes.

Purchase and agency is desired in Vienna, Austria (No. 7,227), for electrical household appliances, such as vacuum cleaners, etc.

Purchase is desired in Algiers, Algeria (No. 7,272), for electric motors, and radio equipment.

An agency is desired in Reval, Esthonia (No. 7,226), for radio equipment.

An agency is desired in Glasgow, Scotland (No. 7,220), for electrical specialties.

Purchase is desired in Asuncion, Paraguay (No. 7,212), for electric wiring supplies and fixtures.

Purchase and agency is desired in Donnybrook, Ireland (No. 7,213), for wireless receiving sets.

Purchase and agency is desired in Habana, Cuba (No. 7,242), for refrigeration plants.

An agency is desired in Adelaide, Australia (No. 7,250), for refrigeration plants for domestic use.

ELECTRIC METERS FOR SYDNEY, AUSTRALIA.—Tenders will be received by the City Council, Sidney, New South Wales, Australia, until Sept. 24 for 1,775 direct-current meters (5 to 150 amp.), and 35,200 single-phase meters (5 to 50 amp.)

PROPOSED POWER PLANT IN ARGENTINA.—Permission has been granted to Señor Mayorino Rossi to construct and operate an electric power plant at Altos de Chipión, in the Department of San Justo, Argentina.

ELECTRIFICATION OF FRENCH RAILROADS.—The first section of the program of the electrification of the Orleans and Midi Railroads, according to *Commerce Reports*, has been approved by the Minister of Public Works. The electrification program for the Midi during the years 1923 to 1927 involves 1,576 km. and includes in addition to the line from Toulouse to Dax, with branches to the Pyrenees, work on which is well advanced, the line from Bordeaux to Irun, with various branches, and the further extension of a number of short Pyrenees lines. The first division of the program for the electrification of the Orleans Railroad involves the electrification of the lines from Paris to Brive, with various side lines, totaling 916 kw.

PROPOSED WATER-POWER DEVELOPMENT IN INDO-CHINA.—Applications have been made by two companies, *Commerce Reports* states, for permission to utilize the falls of Song Nam in the Tonkin mining region for power purposes in connection with tin and zinc reduction plants. It is proposed to utilize 14,000 hp. in an electro-metallurgical plant.

## New Apparatus and Publications

TURBINE.—The B. F. Sturtevant Company, Hyde Park, Boston, is distributing catalog No. 311, covering its type 12 turbine, which is particularly adapted for direct connection to blowers, fans, electric generators and centrifugal pumps.

CONVEYOR FEED STOKER.—"Burning Pocahontas Coal on a Conveyor Feed Stoker" is the title of a bulletin issued by the Laclede-Christy Company, St. Louis, in which it describes results obtained with the "Stowe" stoker at the plant of the Gloucester (Mass.) Electric Company.

LIGHTING FIXTURE.—A new fixture designed especially for kitchen lighting, type "STFD," has been developed by the Edwin F. Guth Company, St. Louis. It is supplied both with and without pull switch.

RADIO APPARATUS.—The Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, England, is distributing supply leaflets Nos. 640/2 and 660/1, describing its "Cosmos" crystal set amplifier and "Cosmos" radiophone protective device respectively.

BATTERY CHARGER.—The Holmes Electrical Manufacturing Company, 3,229 Sheffield Avenue, Chicago, has placed on the market a mechanical rectifier for charging automobile and radio storage batteries.

ELECTRIC STOVE.—The Apex Electrical Manufacturing Company, Cleveland, is now manufacturing a lamp-socket electric stove, known as the "Rotarex Kook-Rite," formerly made by the Electrical Appliances, Inc., Muncie, Ind.

SOCKET.—A socket "Turn-Nob," for use on lamps and portables which can be installed where a socket is not required has been brought out by the E. H. Freeman Electric Company, 10 Prince Street, Trenton, N. J.

FIREBRICK MORTAR.—The leading article in the June issue of the *Laclede-Christy Bulletin*, entitled "Lay Laclede Firebrick with Laclede 'Mortarmix'," calls attention to the use of "Mortarmix" for laying firebrick and gives its advantages over ordinary raw-clay batter.

WASHING MACHINE.—An electric washing machine, "Everybody's," made entirely of metal with the exception of the wringer, has been placed on the market by the Vermont Farm Machine Company, Bellows Falls, Vt.

COIL SHAPER.—An electric coil-duplicating machine has been brought out by W. P. Hunsdorf & Company, 720 Frankfort Avenue, Cleveland.

OIL DEHYDRATOR.—A centrifugal dehydrator permanently attached to the transformer tank has been brought out by the Industrial Products Company, Goshen, Ind.

LIGHTING PLANT.—The Universal Products Company, Oshkosh, Wis., has placed on the market a lighting plant, "Upco," for either 110 watts or 32 watts and a generating capacity of 350 watts.

ELECTRIC BOTTLE TESTER.—A bottle tester which can be driven by hand or motor has been developed by D. H. Burrell & Company, Little Falls, N. Y.

ELECTRIC DISHWASHER.—The Walker Dishwasher Corporation, Syracuse, N. Y., has placed on the market an improved model of the "Walker" dishwasher.

PIPE-THAWING MACHINE.—An electric pipe-thawing machine, equipped with fuses and signal lights for indicating when the machine is operating, has been placed on the market by the Domestc Supplies & Phonograph Company, 314 Spruce Street, Scranton, Pa.

BOX-BAR AND SWITCH SUPPORT.—The Electrical Equipment & Manufacturing Company, 1139 Champlain Street, Toledo, Ohio, has developed a box-bar and switch support "Lead-All."

CONNECTOR AND ANGLE ADAPTERS.—The Rattan Manufacturing Company, New Haven, Conn., has placed on the market a panel-box connector and a 90-deg. angle adapter.

MOTOR-GENERATOR SET.—A motor-generator set for charging storage batteries under the constant-potential system has been placed on the market by Roth Brothers & Company, 1401 West Adams Street, Chicago.

TELEPHONE BATTERY SETS.—Stanley & Patterson, Inc., 250 West Street, New York City, has placed on the market a line of battery sets for the operation of telephone systems.

ELECTRIC CORN POPPER.—The Electrovend Company, Cleveland, has developed an electric corn popper, "Marvel," in which the entire process of popping and separating the corn is exhibited under glass.

ELECTRIC FLASHER.—An automatic electric flasher, "Bossard Flashmore," designed for railway grade-crossing and highway signals, has been placed on the market by the Bossard Railway Signal Corporation, Troy, N. Y.

## New Incorporations

THE OAKBORO (N. C.) POWER & LIGHT COMPANY has been chartered with a capital stock of $50,000 by J. A. Groves, E. E. Snuggs and W. C. Heath.

THE WEYBRIDGE (VT.) LIGHT & POWER COMPANY has been incorporated by B. O. Wales, E. L. Wright, C. C. Shaw, W. T. Sturtevant, H. A. Bois and C. W. Baker of Middleberry. The company is capitalized at $5,000 and proposes to furnish electricity in Weybridge and adjacent towns.

THE WARM SPRINGS POWER COMPANY, Blackfoot, Idaho, has been incorporated with a capital stock of $750,000 to construct and operate power plants and to generate and distribute electricity.

# Construction News

**Projects, Plans, Bids and Contracts Contemplated or Under Way**

## New England States

KEENE, N. H.—Work has begun by the Keene Gas & Electric Company on the construction of a hydroelectric plant at Marlboro, to cost about $300,000. The work includes a power station and reservoir. L. H. Shattuck, Inc., Manchester, is contractor.

PLAISTOW, N. H.—General contract has been awarded by the Merrimac Clay Products Company, 53 State Street, Boston, for its proposed new plant at Plaistow to the L. H. Shattuck Company, Manchester, N. H. The plans include a power house and machine shop.

BOSTON, MASS.—The Walter Baker Company will build a one-story power house at its chocolate plant at 11 Central Street.

FALL RIVER, MASS.—The Montaup Electric Company has applied for permission to issue $600,000 in capital stock, the proceeds to be used for the purchase of electric light and power properties, and for extensions and improvements.

HOLYOKE, MASS.—Plans are being completed and bids will soon be called for the construction of a new municipal electric plant, to cost about $500,000. McClintock & Craig, 33 Lyman Street, Springfield, are engineers.

## Middle Atlantic States

BROOKLYN, N. Y.—The Brooklyn Edison Company plans to erect a one-story addition to its substation at 372 Sumpter Street.

BROOKLYN, N. Y.—The Jamaica Water Supply Company, Shelton Avenue, Jamaica, plans to construct an electrically-operated pumping plant on 128th Street, Richmond Hill.

CANASTOTA, N. Y.—The Adirondack Power & Light Corporation, Amsterdam, has acquired the property of the Canastota Power & Light Company. Extensions and improvements are planned.

ORCHARD PARK, N. Y.—The Depew & Lancaster Light, Power & Conduit Company has applied for a franchise to supply electricity for light and power service here.

OSSINING, N. Y.—Bids will be received by Charles F. Rattigan, superintendent of state prisons, Capitol, Albany, until July 31 for construction of refrigeration plant, clinic building No. 8, and building No. 4, electric elevators, mess hall and kitchen building, No. 4; one 200-kw., direct-current generating set, etc., at the Sing Sing Prison, Ossining. Sullivan W. Jones is state architect.

UTICA, N. Y.—The Utica Gas & Electric Company contemplates the construction of a hydro-electric plant in the vicinity of Canada Lake, Stewarts Landing.

WATERTOWN, N. Y.—Arrangements are being made by the Power Corporation of New York to purchase the Soft Maple dam site on the Beaver River. It proposes to build a hydroelectric plant, to include power house, concrete dam, penstock, high-tension transmission line, etc., to cost about $500,000. W. P. McCreager, Northern New York Trust Company Building, is chief engineer.

CAMDEN, N. J.—The Philadelphia & Reading Railroad Company, Reading Terminal, Philadelphia, plans to build a storage battery plant at its new local terminal.

HADDONFIELD, N. J.—The Iona Light, Heat & Power Company, recently organized, plans to furnish electricity for light in this section. Theodore Blank, Haddonfield, heads the company.

NEWARK, N. J.—The Public Service Electric Company plans to build a substation at 304-12 Norfolk Street, to cost about $78,000.

PENNINGTON, N. J.—Bids will be received by the Borough Council, Henry L. Laning, clerk, until August 26, for electrically-operated pumping machinery for

the municipal waterworks. Remington & Vosbury, 601 Market Street, Camden, are engineers.

BERLIN, PA.—The power plant of the John O. Ream Mining Company was recently damaged by fire, causing a loss of about $25,000.

CONEWAGO, PA. — The Conewago-Dauphin and Londonderry-Dauphin Electric Companies, recently organized, are planning to erect a transmission line for light and power service in this section. L. D. West and W. H. Schubert head the companies. Olmstead, Snyder & Miller, Harrisburg, are representatives.

COOPERSBURG, PA. — The Pennsylvania Power & Light Company, Allentown, has acquired the system of the Coopersburg Electric Light & Power Company. A substation will be built and extensions made in transmission system.

EASTON, PA.—The Pennsylvania Edison Company has contracted with the Saylorsburg (Pa.) Light & Power Company, for power supply and will erect a transmission line to this point. Plans are being considered for building a transmission line for service to a number of communities in the vicinity of Stroudsburg.

LATROBE, PA.—The West Penn Railways Company, Pittsburgh, is preparing plans for the erection of a new power plant in the Kingston section, to cost about $500,000.

PHILADELPHIA, PA.—A power house will be erected at the textile plant of the Philadelphia Tapestry Mills, Inc., Hutchinson Street.

PHILADELPHIA, PA. — The Frank Schoble Company will build a power house at its hat-manufacturing plant at Tenth and Oxford Streets, to cost about $40,000.

PHILADELPHIA, PA.—Electric power equipment will be installed in the new printing plant to be erected at Broad and Callowhill Streets by the "Philadelphia Inquirer," to cost about $600,000.

PHILADELPHIA, PA.—Fred Pearson & Company, Inc., will build a power house at its plush mill at Leverington and Wilde Streets. W. E. S. Dyer, Land Title Building, is engineer.

PHILADELPHIA, PA.—The Bureau of Water will install electrically-operated pumping equipment in a new station at Germantown and Southampton Avenues. Fred C. Dunlap is chief of the bureau.

PHILADELPHIA, PA.—The Philadelphia Electric Company has contracted with the Pennsylvania Railroad for power supply for the Broad Street Station and office building, and will install a substation for the service to cost about $25,000.

SHENANGO, PA.—The North, South and West Shenango Township Light & Power companies have been chartered to install and operate electric systems in the respective townships. A. A. Culbertson, Erie, is treasurer of all three utilities.

BALTIMORE, MD.—The Flynn & Emrich Company, 305 North Holiday Street, is planning to erect a new plant on Taylor Avenue, consisting of a machine shop, foundry, power house, etc., to cost about $75,000.

BALTIMORE, MD.—Electric power equipment will be installed in the proposed printing plant to be erected by the "Baltimore News and American," at Commerce and Pratt Streets, to cost about $500,000. G. R. Vallis, Jr., American Building, is architect.

BALTIMORE, MD. — The Consolidated Gas, Electric Light & Power Company plans to erect an addition to its substation at 700-24 West Pratt Street. An extension will also be built at the battery station, 10-12 McClellan Street, to cost $32,000.

CHARLESTON, W. VA.—A site has been acquired on California Avenue for the proposed power plant for the new State Capitol Building.

NORFOLK, VA. — The Norfolk Sugar Refining Company will build a power house in connection with its proposed local refinery to cost about $3,000,000.

## North Central States

DUNDEE, MICH.—The plant of the Dundee Power Company has been acquired by the Detroit Edison Company. A substation will be erected and electricity will be supplied from Detroit.

LANSING, MICH.—The erection of a power house, to cost about $100,000, at the State Industrial School for Boys is under consideration.

NORTHVILLE, MICH.—The Ford Motor Company plans to construct a power plant at its local works. Albert Kahn, 1000 Marquette Building, Detroit, is architect.

AKRON, OHIO. — The Northern Ohio Traction & Light Company contemplates building a substation at 461 Water Street, to cost about $135,000. J. E. Eckrode, Terminal Building, is engineer.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Aug. 3 for economizers, forced and induced draft fans for the division of light and power.

COLUMBUS, OHIO. — The Pennsylvania Railroad Company plans to construct a new power house at its local shops.

HAMILTON, OHIO.—The Council is considering the construction of a municipal electric light and power plant, to cost $650,000, for which bonds have been voted, to replace the present plant.

WARREN, OHIO. — The Ohio Public Service Company has issued bonds for $500,000, part of the proceeds to be used for extensions and improvements.

BURNSIDE, KY.—Application has been made to the Federal Power Commission by the Cumberland Hydro-Electric Power Company, Ind., for permission to build three power projects on the Cumberland River, two above Burnside, and one on the south Fork of the Cumberland River, to cost about $900,000, including a steel tower transmission line.

WHITESBURG, KY.—The Kentucky & Virginia Power Company, Hazard, is planning to extend its transmission lines to Logan, in the coal field of West Virginia. From Logan connection will be made with Charleston, and from there the lines will eventually be extended to Wheeling.

CAMBRIDGE, IND.—Extensions and improvements are contemplated by the Cambridge Light & Power Company, to cost about $50,000.

FORT WAYNE, IND.—Plans are under way by the National Han le Company for the erection of the first unit of its proposed plant on Erie Street, including power house, to cost about $100,000.

FORT WAYNE, IND.—Plans are being prepared for the construction of a power plant at Concordia College. J. M. Riedel, 305 Noll Building, is architect.

SOUTH BEND, IND.—The Studebaker Corporation has begun work on the erection of a new foundry, 683 ft. by 732 ft., a car storage building and crane shed, 59 ft. by 76 ft., by 722 ft., and an addition to the power plant, 68 ft. by 89 ft.

AURORA, ILL. — The Aurora Cotton Mills plan to install a new lighting system and to electrify all departments of their plant. Lockwood, Greene & Company, 38 South Dearborn Street, Chicago, are engineers.

CHICAGO, ILL. — The Commonwealth Edison Company contemplates the construction of three substations, to be located on Marshfield Avenue, near Fifty-first Street, at Harrison and Des Plaines Streets, and on Center Street near Cleveland Avenue, respectively.

VENICE, ILL.—The Illinois Power & Light Corporation plans to construct a local power plant, to cost $1,200,000, with transmission system.

ALGOMA, WIS.—The City Council has given its approval of an ornamental lighting system in Lakeside Park.

BARRON, WIS.—The City Council has decided to build a new hydro-electric plant at the Taylor Dam, to cost about $15,000, which will be supplementary to the present municipal plant.

MILWAUKEE, WIS.—Bids, it is understood, will soon be asked by the city of Milwaukee for coal and ash-handling equipment for the steam generating unit of the Riverside pumping station. R. E. Stoelting is commissioner of public works.

COON RAPIDS, IOWA.—The Iowa Railway & Light Company, Des Moines, has been granted a franchise to erect a high-tension transmission line from Coon Rapids to Glidden.

HAMPTON, IOWA.—The Hampton Brick & Tile Company contemplates the construction of a power house at its proposed tile-manufacturing plant, to cost about $80,000.

MANNING, IOWA. — Preliminary plans are being prepared by A. Dohmen, architect, 68 Wisconsin Street, Milwaukee, for a hospital building and power house and laundry, to be erected in Manning, to cost about $300,000.

RED OAK, IOWA—The State Railroad Commission has granted the Iowa Service Company permission to erect a transmission line from Red Oak to Villisca.

CAMERON, MO.—At an election held recently the proposal to issue $75,000 in bonds for improvements to the municipal electric lighting and water systems was defeated. Another election, it is understood, will soon be held. E. E. Harper, 3031 Park Avenue, Kansas City, is engineer.

DREXEL, MO.—The installation of electrically-operated pumping machinery at the new municipal waterworks is under consideration by the City Council. J. P. Davis, Central Trust Building, Jefferson City, is engineer.

GLASGOW, MO.—The Kansas City (Mo.) Power & Light Company, it is understood, will build a large power plant at Glasgow to furnish service in this district, including Blackburn, Sweet Springs, Mayview, and Waverly.

KANSAS CITY, MO.—Electric power equipment will be installed at the proposed waterworks plant, to be constructed by the Board of Fire & Water Commissioners, to cost about $1,000,000. Fuller & Maitland, Kansas City, are consulting engineers.

ORAN, MO.—Preliminary plans are under way for the construction of a municipal power plant in conjunction with a waterworks station, to cost about $65,000. The W. A. Fuller Engineering Company, Railway Exchange Building, St. Louis, is engineer.

HOT SPRINGS, S. D.—The Water, Light & Power Company contemplates extensive improvements to its plant and distributing system including the construction of an auxiliary plant.

MILLER, NEB.—Plans are under way for the erection of an electric transmission line from Miller to Sumner for local commercial service. A. N. Bliss is town clerk.

TOPEKA, KAN.—The City Council is considering the installation of ornamental lamps on Quincy Street.

## Southern States

KINSTON, N. C.—Bids will be received by the Caswell Training School, until July 31, for equipment for a steam-operated electric generating plant. H. A. Underwood, Commercial Bank Building, Raleigh, is architect.

RALEIGH, N. C.—Bids will be received by the Board of City Commissioners, until August 1, for electrically-operated pumping machinery at the municipal waterworks, in connection with extensions to cost $350,000. C. C. Page is engineer.

FERGUSON, S. C.—The Columbia Railway & Navigation Company, Columbia, has been granted a preliminary permit by the Federal Power Commission to construct a hydroelectric plant on the Santee River, with initial capacity of 125,000 hp., to cost about $1,500,000.

THOMASVILLE, GA.—The Georgia-Alabama Power Company, Albany, it is reported, contemplates the erection of a high-tension transmission line from Pelham to Thomasville, to supply energy here.

OCALA, FLA.—The Marion County Lime Company, recently organized, contemplates the construction of a power house at its proposed local lime plant, to cost about $100,000.

CHATTANOOGA, TENN.—The installation of an ornamental lighting system on Eighth Street is under consideration.

KNOXVILLE, TENN.—Bids will be received by L. S. Pope, director of institutions, Nashville, until Aug. 16 for construction of school building, dormitory and power plant at the State Deaf and Dumb School in Knoxville, to cost about $250,000. Marr & Holman, Stahlman Building, Nashville, and Barber & McMurray, Burwell Building, Knoxville, are architects.

MEMPHIS, TENN.—Plans are under way by the Wabash Screen Door Company, Florida Street and Trigg Avenue, to double the output of its power plant, at a cost of about $50,000.

MEMPHIS, TENN.—The Indiana Board & Fiber Company contemplates the construction of a power house at its proposed local pulp mill, to cost about $500,000.

NASHVILLE, TENN.—Bids will be received by J. H. Kirkland, chancellor of Vanderbilt University, until Aug. 14 (extension of date from July 16) for construction of hospital and laboratory, nurses' home, power plant and laundry on Campus, to cost about $2,000,000. Coolidge & Shattuck, 122 Ames Building, Boston, are architects.

SHELBYVILLE, TENN.—The Southern Cities Utilities Company, Chattanooga, is planning to erect a power plant at Shelbyville.

MONTGOMERY, ALA.—The City Commission is considering an ordinance requiring all electric wires in the fire district to be placed underground.

LEAKESVILLE, MISS. — The Leakesville Veneer & Lumber Company, recently organized, contemplates the construction of a power plant in connection with a new mill, to cost about $200,000. Max Bryant is head.

CONWAY, ARK.—The installation of a 200-hp. oil-engine generating unit in the municipal electric plant is under consideration.

MANGUM, OKLA.—An election will soon be called to vote on the proposal to issue $8,000 in bonds for extensions to the municipal electric plant.

MINCO, OKLA.—The Chickasha (Okla.) Gas & Electric Company has acquired the local municipal electric plant, which it will remodel for a substation. A transmission line erected to Minco.

BRECKENRIDGE, TEX.—The Thermatomic Carbon Company, Sterlington, La., contemplates the construction of a power plant in connection with its proposed local helium works, to cost about $250,000.

CALVERT, TEX.—The Western Public Service Company, Colorado Springs, Col., has acquired the system of the Calvert Water, Ice & Electric Company. Extensions and improvements will be made, including the erection of a transmission line.

DALLAS, TEX.—The Texas Power & Light Company will construct a 22,000-volt transmission line to the Powell oil fields, about 12 miles. A substation will also be erected in the Powell district.

FORT WORTH, TEX.—The Trinity Portland Cement Company, Dallas, plans to construct a power plant in connection with its proposed local cement mill, to cost about $750,000.

HOUSTON, TEX.—The Houston Lighting & Power Company contemplates the construction of a substation on Yale Street, to cost about $140,000.

PORT ARTHUR, TEX. — The Eastern Texas Electric Company is preparing plans for an addition to its power plant at Riverside Drive and Houston Avenue, to be equipped for switching and distributing service, to cost about $135,000. It is also proposed to build a steel tower transmission line to Beaumont, to cost about $300,000. Stone & Webster, Inc., 147 Milk Street, Boston, is engineer.

## Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Bureau of Yards & Docks, Navy Department, Washington, D. C., until August 15, for one electric traveling bridge crane at the Puget Sound Navy Yard. (Specification 4861.)

FULLERTON, CAL.—The Clay Products Company contemplates building a power house in connection with a new tile manufacturing plant to cost about $85,000.

GLENDALE, CAL.—The installation of a 400-hp. synchronous motor in the municipal electric light plant is under consideration.

LOS ANGELES, CAL.—The Los Angeles Molasses Feed Company, recently organized, plans to construct a power house in connection with its proposed plant on Terminal Island, to cost about $350,000. J. A. Love, Kansas City, Mo., heads the company.

MODESTO, CAL.—The Modesto Irrigation District plans constructing an electric substation on Coldwell Avenue.

PITTSBURGH, CAL.—The Pacific Gas & Electric Company, San Francisco, is planning to erect a local substation, to cost about $100,000.

SAN DIEGO, CAL.—Bids will be received by the Bureau of Yards & Docks, Navy Department, Washington, D. C., until August 15, for electrical installation at the local navy yard. (Specification 4821). Also for wiring in the mess hall at the naval station. (Specification 4843.)

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company plans to erect a power plant, on Stevenson Street near Fifth Street, to cost about $250,000. The company is also building a substation on East Fiftieth Avenue, Oakland.

SAN LEANDRO, CAL.—The installation of an electric lighting system on Davis Street is under consideration.

SANTA BARBARA, CAL.—Steps have been taken by the Chamber of Commerce for the installation of an ornamental lighting system on State Street from Ocean Front to Mission Street.

FLORENCE, ARIZ.—The board of directors of the Electrical district No. 2 has called an election to vote on the proposal to issue $528,150 in bonds, to be used for the erection of a transmission line to Florence.

NEEDLES, ARIZ.—G. H. Stetson, 8 Fortieth Street, New York City, has applied to the Federal Power Commission for permission to construct and operate a hydro-electric plant on the Colorado River, near Bulls Head Rock, in the vicinity of Needles, with an initial capacity of 160,000 hp.; also to build a plant at Bouldre Canyon River on the Colorado River.

## Canada

REDCLIFF, ALTA.—The local power plant, owned by the municipality of Medicine Hat, was recently destroyed by fire, causing a loss of about $15,000.

ACTON, ONT.—The Hydro-Electric Commission of Ontario contemplates the installation of three 100-kva. transformers in the local station.

GALT, ONT.—Plans are under consideration to change the voltage of the local system from 2,200 to 4,000. The installation of a second power line to the west side is under consideration.

KENORA, ONT.—The installation of new equipment, including boilers, in the municipal electric light plant is under consideration.

OTTAWA, ONT.—The Lower St. Lawrence Power Company has been granted permission to erect a transmission line from Rimoski to Riviere Metis, a distance of about 22 miles.

OTTAWA, ONT. — The Ottawa Light, Heat & Power Company plans to issue $6,000,000 in bonds, part of the proceeds to be used for extensions and improvements.

TORONTO, ONT.—The Hydro-Electric Power Commission of Ontario contemplates building an addition to the transformer station on Davenport Street, to cost about $150,000. F. A. Gaby is chief engineer.

## Electrical Patents

**Announced by U. S. Patent Office**

**(Issued July 10, 1923)**

15,644 (reissue). LINE SWITCH; J. N. Reynolds, Greenwich, Conn. App. for reissue filed June 7, 1921. Construction and assembly of a crossbar switch for telephone mechanism.

15,652 (reissue). OPERATOR'S OUTFIT FOR ELECTRIC WELDING; W. Woltmann, New York, N. Y. App. for reissue filed Dec. 31, 1919. Welding machine with fixed voltage and amperage.

1,461,056. SIGNALING APPARATUS; W. L. Walker, New York, N. Y. App. filed June 22, 1917. Submarine signaling apparatus.

1,461,064. MULTIPLEX TRANSMISSION CIRCUITS; DeL. K. Martin, Orange, N. J. App. filed Feb. 10, 1921. Employs carrier currents for communication.

1,461,072. RHEOSTAT WITH AUXILIARY CONTACT SYSTEM; D. H. Sheriff, Jr., Kansas City, Mo. App. filed Dec. 4, 1922. For electron tubes.

1,461,100. METHOD OF TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; H. H. Smith, Newark, N. J. App. filed Dec. 19, 1917. Treatment to prevent filaments from sagging.

1,461,103. GOVERNOR FOR ELECTRIC CIRCUITS; E. J. Tomlinson, Newark, N. J. App. filed June 8, 1920. For phonograph motors.

1,461,117. FILAMENTARY BODY FOR ELECTRIC LAMPS AND METHOD OF MAKING THE SAME; R. D. Hall, East Orange, and H. H. Smith, Newark, N. J. App. filed Dec. 19, 1917. Method of preventing filament from sagging.

1,461,118. FILAMENT; R. D. Hall, East Orange, N. J. App. filed Dec. 19, 1917. Non-sagging filament.

1,461,140. METHOD OF TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; J. H. Ramage, Norfolk, Va. App. filed Oct. 15, 1917. To prolong life of filament.

1,461,143. INDICATOR FOR VACANT THEATER SEATS; W. L. Guerin, New Orleans, La. App. filed Dec. 23, 1921. Lamp for each seat on indicating board.

1,461,155. METHOD OF AND APPARATUS FOR MANUFACTURING INCANDESCENT LAMPS; H. D. Madden, Irvington, and J. J. Higgins, East Orange, N. J. App. filed April 3, 1919. Machine for exhausting and then filling gas filled lamps.

1,461,183. SUBSTATION CIRCUIT; H. Fletcher, New York, N. Y. App. filed Dec. 15, 1920. Preventing side tones in telephone receiver due to currents in local transmitter.

1,461,204. SIGNALING SYSTEM; J. H. Bell, South Orange, N. J. App. filed April 17 1920. Printing telegraph system in which single station records message.

1,461,207. AUTOMATIC ELECTRIC CIRCUIT CONTROL MECHANISM; F. J. Bonk and A. W. Stewart, Ripon, Wis. App. filed Dec. 19, 1921. Electric sign flasher.

1,461,212. TELEPHONE EXCHANGE LINE SWITCH; H. F. Dobbin, New York, N. Y. App. filed Aug. 24, 1920. Truck selecting switch for automatic exchange.

1,461,215. SIGNAL; J. H. Hunt, Dayton, O. App. filed Sept. 30, 1919. Used with battery charging systems of automobiles

1,461,220. SUBMARINE SIGNALING; C. R. Moore, Wyoming, N. J. App. filed July 28, 1919. Acoustic device for detecting or receiving vibrations set up in water

1,461,221. TELEPHONE EXCHANGE SYSTEM; L. A. Mortimer, New York, N. Y. App. filed Nov. 19, 1920. Signaling arrangements for link circuits.

1,461,232. FILAMENT SUPPORT; S. Thronsen, Chicago, Ill. App. filed Sept. 3, 1918. Construction of three-electrode electron tubes.

1,461,234. SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRIC CURRENTS; C. H. Tower, Cleveland, O. App. filed April 3, 1919. Automobile generator for battery charging, lighting and ignition.

1,461,238. OZONIZER; M. W. Willson, Mount Carmel, Ill. App. filed March 3, 1922. For converting oxygen into ozone for commercial use.

1,461,251. AUTOMOBILE SIGNAL; P. McLaren, Whittier, Cal. App. filed May 23, 1921. Rear direction signal.

1,461,276. APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF METALLIC ALLOYS IN THE FORM OF PASTE OR SLUDGE; B. Leech, Macclesfield, England. App. filed March 16, 1920.

1,461,287. HIGH-TENSION CONDENSER; E. Pfiffner, Frybourg, Switzerland. App. filed Jan. 10, 1922. For distributing voltage stress over entire chain of insulators.

1,461,323. LAWN MOWER; J. W. Peters, Roslyn, N. Y. App. filed March 2, 1921. Electrical operating gathering reel mower controlled from single point.

1,461,359 and 1,461,360. ELECTRIC GAS LAMP; A. Lederer, Vienna, Austria. App. filed July 18, 1914. Neon lamp.

1,461,383. CAP FOR GREASE CUPS; W. H. Durant, Somerville, Mass. App. filed Oct. 3, 1921. Automatically feeds grease to bearings.

1,461,446. COMMUTATING SYSTEM FOR ELECTRICAL MACHINES; C. L. A. M. Leblanc, Paris, France. App. filed Sept. 15, 1920. Improved method of short-circuiting commutator bars.

1,461,492. ELECTRICAL TESTING INSTRUMENT; J. F. Moody, Brooklyn, N. Y. App. filed June 24, 1920. For locating underground cables.

1,461,512. CONTROL SYSTEM; E. M. Bouton, Wilkinsburg, Pa. App. filed Sept. 17, 1920. Automatic resistance cutout for starting motors.

1,461,528. AUTOMATIC SWITCH; F. S. Irvine, Huntington, N. Y. App. filed Sept. 22, 1920. For selecting circuits in automatic telephone system.

1,461,534. STEAM-LOCOMOTIVE LIGHTING SYSTEM. A. McGary, New York, N. Y. App. filed Feb. 11, 1920. Alternating current generator for headlights with step-down transformer for cab lights.

1,461,540. ELECTRIC LANTERN; T. Mee, Jr., Clinton, Ill. App. filed June 9, 1921.

1,461,542. DYNAMO ELECTRIC MACHINE; A. H. Neuland, Jersey City, N. J. App. filed Aug. 24, 1920. Electric-magnetic power transmission for automobiles, railway cars and hoists.

1,461,551 to 1,461,553. ELECTRIC SHIP PROPULSION; A. H. Mittag, Schenectady, N. Y. App. filed Sept. 24, 1921. Control of alternating current propelling motor.

1,461,568. TELEGRAPHIC RECEIVING INSTRUMENT; C. Adams-Randall, New York, N. Y. App. filed Sept. 27, 1920.